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**Since 1970**



## **Wadsworth v. Jetson Electric Bike, LLC et al.**

### **Electrical Evaluation**

Party Client Represents: Jetson Electric Bikes, LLC  
Loss Location: 1620 Highway 374  
Green River, Wyoming

Date of Incident: February 1, 2022

Prepared for:

**Eugene M. LaFlamme, Esquire**  
**McCoy Leavitt Laskey, LLC**

N19 W24200 Riverwood Drive, Suite 125  
Waukesha, Wisconsin 53188

Case No. 2:23-cv-00118-NDF

**S-E-A Matter No. 06.136153**

Issue Date: September 13, 2024

Signed by:



This item has been digitally signed and sealed by Samuel G. Sudler, III P.E. on 09/13/2024. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

**EXHIBIT G**

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## Acronyms, Abbreviations and Definitions

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|        |   |
|--------|---|
| UL     | Underwriters Laboratories                         |
| IEEE   | Institute of Electrical and Electronics Engineers |
| ANSI   | American National Standards Institute             |
| IEC    | International Electrotechnical Commission         |
| NFPA   | National Fire Protection Association              |
| C.T.   | Computer Tomography                               |
| JISC   | Japanese Industrial Standards Committee           |
| BMS    | Battery Management System                         |
| S.O.C. | State of Charge                                   |
| OEM    | Original Equipment Manufacturer                   |
| SEM    | Scanning Electron Microscopy                      |
| EDS    | Energy Dispersive Spectroscopy                    |
| USB    | Universal Serial Bus                              |
| NSI    | North Star Imaging                                |
| mAh    | milli-Ampere-Hour                                 |
| FMEA   | Failure Mode and Effect Analysis                  |
| ETP    | Eskra Technical Products                          |
| NREL   | National Renewable Energy Laboratories            |
| NASA   | National Aeronautical and Space Administration    |
| LIB    | Lithium Ion Battery                               |
| CID    | Current Interrupting Device                       |



## I. Executive Summary

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### Matter Assignment

On September 13, 2023, McCoy, Leavitt, & Laskey, LLC requested SEA, Ltd. (S-E-A) to conduct an electrical evaluation and investigation in connection with the fire loss that occurred at the Wadsworth residence (The Residence), on February 1, 2022, located at 1620 Highway 374 in Green River, Wyoming. The investigation was assigned to S-E-A Senior Electrical Engineer Samuel G. Sudler III, P.E., IntPE, DFE, F.NSPE, C.F.E.I., C.V.F.I. as S-E-A Matter No. 06.136153. Eugene M. LaFlamme, Esquire of McCoy Leavitt Laskey, LLC represents the interests of Jetson Electric Bikes, LLC (Jetson) and Walmart.

### Scope

Specifically, S-E-A was requested to conduct an electrical evaluation and investigation to determine, if possible, whether the cause of the fire loss was associated with the Jetson Plasma Hoverboard device.

### Methodology

The investigation and analysis of any fire-related incident is a complex and scientific endeavor. The methodology of such an endeavor, therefore, must include the comprehensive, objective, and accurate compilation and analysis of the available data. The methodology utilized by S-E-A in the investigation of this fire incident was *The Scientific Method*, in accordance with the requirements of NFPA 1033, *Standard for Professional Qualifications for Fire Investigator*, and the principles of NFPA 921, *Guide for Fire and Explosion Investigations*.

### Conclusions

**Based upon the joint evidence examinations, discovery documents, depositions, NREL/NASA documentation, expert reports, reference material, UL Certification and Standards, ANSI Standards, and IEC Standards, electrical engineering knowledge, training, education, and experience within a reasonable degree of engineering certainty:**



- It is the opinion of S-E-A that the subject hoverboard, found in the area of origin identified by M.J. Schulz & Associates, was not the cause of the fire.
- It is the opinion of S-E-A that the Jetson Model Plasma hoverboard was designed, functioned, and operated in accordance with all applicable standards, and that all battery cells adhered to the IEC 62133-2 testing and standards.
- It is the opinion of S-E-A that the subject Jetson Model Plasma hoverboard contained 18650 lithium-ion battery cells associated with the battery pack, manufactured by Jiangxi Jiuding Power New Energy Technology Co. Ltd., were designed, functioned, and operated in accordance with all applicable standards, and that this incident was not caused by an internal short circuit that would have resulted in a thermal runaway failure within any of the recovered subject battery cells.
- It is the opinion of S-E-A that the subject 18650 lithium-ion battery cells identified by BEAR, as Cell 4 and Cell 10, do not have enough energy to cause this fire as the Jetson Model Plasma hoverboard was not plugged in at the time of the incident, which invalidates the BEAR opinion that an internal short circuit in batteries Cell 4 and Cell 10 caused this fire.
- It is the opinion of S-E-A that manufacturers of products, such as Jiangxi Jiuding Power New Energy Technology Co. Ltd., have and continue to utilize the UL and IEC testing shown in the results of those respective test reports as its tool to be a practical FMEA as it addresses all known and potential failure modes outlined in the UL, IEC, and other applicable standards that are utilized by other lithium-ion battery manufacturers. It is further the opinion of S-E-A that the CPSC Safety Alert was not related to the subject Jetson Model Plasma and is therefore not pertinent to the investigation of the Wadsworth fire.




## Signatures

S-E-A and the undersigned hereby certify that the opinions and conclusions expressed herein are based upon the application of reliable principles and scientific methodologies to all of the facts known by S-E-A and the undersigned when this report was issued, as well as knowledge, skill, experience, training and/or education. Should additional information be discovered, S-E-A and the undersigned reserve the right to appropriately amend or augment these findings.

Prepared By:

Technically Reviewed By:

DocuSigned by:  
  
0C8EE10561B34EE...

*Robert House/sl*

Samuel G. Sudler III, P.E., IntPE, DFE, CFEI  
Senior Electrical Engineer  
State of Wyoming  
License No. 16066

Robert House



## II. Procedures

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1. **On October 30, 2024 and October 31, 2024, a joint evidence examination was conducted at the Palmer Engineering and Forensic (Palmer Engineering) facility located in North Salt Lake, Utah by S-E-A Senior Electrical Engineer Samuel G. Sudler III, P.E., IntPE, DFE, C.F.E.I. on behalf of Jetson and Walmart, as well as interested parties, at which time the following investigative tasks were performed:**
  - The remains of all of the artifacts collected from the Wadsworth fire as well as the remains of the subject hoverboard and its associated lithium-ion battery cells from the subject hoverboard were documented in the form of photographs, diagrams, and notes.
  - Radiograph (X-Ray) images of the various artifacts were taken and distributed to all interested parties.
2. **On February 29, 2024, a joint evidence exam was conducted at the Berkeley Engineering and Research (BEAR) facility located in Berkeley, California by S-E-A Senior Electrical Engineer Samuel G. Sudler III, P.E., IntPE, DFE, C.F.E.I. on behalf of Jetson and Walmart, as well as Derek King, P.E. of BEAR on behalf of the Wadsworth family, at which time the following investigative tasks were performed:**
  - The subject hoverboard as well as the lithium-ion batteries from the subject hoverboard were examined in detail and were documented in the form of photographs, diagrams, and notes.
3. **Prior to the issuance of this report, various materials were researched, obtained, and/or reviewed, including but not limited to the following:**
  - Discovery materials provided by McCoy Leavitt Laskey, LLC;
  - Report by Derek King, P.E. from BEAR dated July 12, 2024;
  - Report by Michael J. Schulz of M.J. Schulz & Associates, dated July 15, 2024;
  - Computed Tomography (CT) Scan Data was obtained and reviewed.
  - Underwriters Laboratories, Inc. (UL) Certification No. BBCV2.MH19896 for LG Energy Solution, LTD using the basic standard UL 1642;
  - UL 1642 Safety Standard for "Lithium Batteries;"
  - UL 2054 Safety Standard for "Household and Commercial Batteries;"
  - UL 2272 Safety Standard for "Electrical Systems for Personal E-Mobility Devices;"



- UL 2580 Safety Standard for “Batteries for Use in Electric Vehicles;”
- IEC 62133-2 Secondary cells and batteries containing alkaline and other non-acid electrolytes - Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications - Part 2: Lithium Systems
- National Fire Protection Association (NFPA) 921, “Guide for Fire and Explosion Investigations,” 2014 and 2017 Editions;
- Institute of Electrical and Electronics Engineers (IEEE) 1584™-2002 – IEEE Guide for Performing Arc Flash Hazard Calculations;
- Fundamental Engineering Reference Handbook by NCEES;
- Fundamentals of Thermodynamics, by Claus Borgnakke and Richard E. Sonntag;
- Heat Transfer: A Practical Approach, by Yunus A. Cengel;
- Kirk’s Fire Investigation, Sixth Edition, by John D. DeHaan;
- Ignition Handbook, by Vytenis Babrauskas;
- National Institute of Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards, by the Department of Health and Human Services – Center for Disease Control and Prevention (CDC);
- CRC Handbook of Chemistry and Physics, Editor-In-Chief David R. Lide, 91st Edition;
- Handbook of Batteries, Third Edition, by David Linden and Thomas B. Reddy;
- Battery Technology Handbook, Second Edition, Edited by H.A. Kiehne;
- Lithium-ion Batteries – Fundamentals and Applications, Edited by Yuping Wu;
- Lithium-Ion Batteries Hazard and Use Assessment (Springer Briefs in Fire), Celina Mikolajczak, Michael Kahn, Kevin White and Richard Thomas Long;
- "Safe Lithium-Ion Battery Designs for Use, Transportation and Second Use," by Judy Jeevarajan, Ph.D.;
- National Aeronautical and Space Administration (NASA) Engineering and Safety Center Technical Bulletin No. 09-02, “Limitations of Internal Protective Devices in High-Voltage/High-Capacity Batteries Using Lithium-Ion Cylindrical Commercial Cells;”
- Lithium-ion Rechargeable Batteries -Technical Handbook by Sony Electronics;
- “Safety mechanisms in lithium-ion batteries,” by P.G. Balakrishnan, R. Ramesh, T. Prem Kumar in Journal of Power Sources, 155 (2006) 401-414;



- "Thermal runaway caused fire and explosion of lithium-ion battery," by Qingsong Wang, Ping Ping, Xuejuan Zhao, Guanquan Chu, Jinhua Sun, Chunhua Chen in *Journal of Power Sources*, 208 (2012) 210-224;
- "Arc analysis to the CID of Li-Ion battery cells in high-current applications," by A. Augeard, T. Singo, P. Desprez, F. Perisse, S. Menecier and M. Abbaoui, at *2014 IEEE 60th Holm Conference on Electrical Contacts (Holm)*, New Orleans, LA, 2014, pp. 1-7;
- "Less Fire, More Power: The Secret to Safer Lithium-Ion Batteries," Weiyang Li and Yi Cui, in *IEEE Spectrum*, August 23, 2018;
- "Review of Specific Heat Capacity Determination of Lithium-Ion Battery," Yu Tang, Tao Li, and Ximing Cheng, at 10<sup>th</sup> International Conference on Applied Energy (ICAE2018), 22-25 August 2018, Ong Long, China;
- "Thermal Impedance Spectroscopy for Li-Ion Batteries with an IR Temperature Sensor System," Peter Keil, Katharina Rumpf and Andreas Jossen, 27<sup>th</sup> Annual Electric Vehicle Symposium, November 17-20, 2013, Barcelona, Spain;
- "Thermal Properties of Lithium-Ion Battery Components," Hossein Maleki, Said Al Hallaj, J. Robert Selman, Ralph B. Dinwiddie and H. Wang, *Journal of The Electrochemical Society*, 146(3) 947-954 (1999);
- William J. Meese and Robert W. Beausoliel, "Exploratory Study of Glowing Electrical Connections" National Bureau of Standards (NBS) Building Science Series 103, October 1977; and
- Bruce V. Ettling, "Glowing Connections" *Fire Technology* 18, No. 4 (1982): 344-349.

S-E-A may rely on the materials listed above and referenced in this report to support the opinions expressed at trial.



### III. Discussion

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#### Background

The Sheriff's Department incident report notates a fire at the Residence that left one adult female and one small child with burn injuries. A passer-byer, Ryan Pasborg was able to retrieve the woman and 4 children from the residence while waiting for the arrival of an EMT. Upon arrival, Deputy Sheriff (DS) John Hansen, the responding officer, observed the property engulfed in flames with heavy smoke that prevented him from viewing the interior of the home. DS Hansen then walked around the perimeter of the home and observed a power line that was detached from the home but connected to the power pole. He further observed the electricity breaker to shut off power to the residence was in the engulfed area of fire. Subsequently, the Green River Fire Department was contacted and arrived on the scene to extinguish the fire and noted the "cause of ignition" to be an alleged failure of equipment or heat source.

#### Joint Laboratory Examinations

Joint laboratory examinations of the retained artifacts were conducted on October 30, 2024 and October 31, 2024 at the Palmer Engineering facility located in North Salt Lake, Utah and on February 29, 2024 at the BEAR facility located in Berkeley, California by S-E-A Senior Project Engineer Samuel G. Sudler, III, P.E., IntPE, DFE, F.NSPE, C.F.E.I., on behalf of Jetson and Walmart, as well as other interested parties. The artifacts were previously examined by all interested parties prior to S-E-A's involvement. Consequently, Palmer Engineering shared their radiographs (X-Rays) with S-E-A to assist with collecting pertinent data. The examinations were conducted to determine if any of the artifacts exhibited evidence of a failure capable of causing the fire at the Wadsworth property.

All of the artifacts (as shown in **Figure 1**) were examined in detail during the joint laboratory examinations. While all the items were examined, items of particular interest in the area of fire origin determined by M.J. Schultz & Associates, as seen in **Figure 2**, were as follows:

- The remains of the two cylindrical 18650 battery cells
- The remains of the subject hoverboard and its associated 18650 battery cells



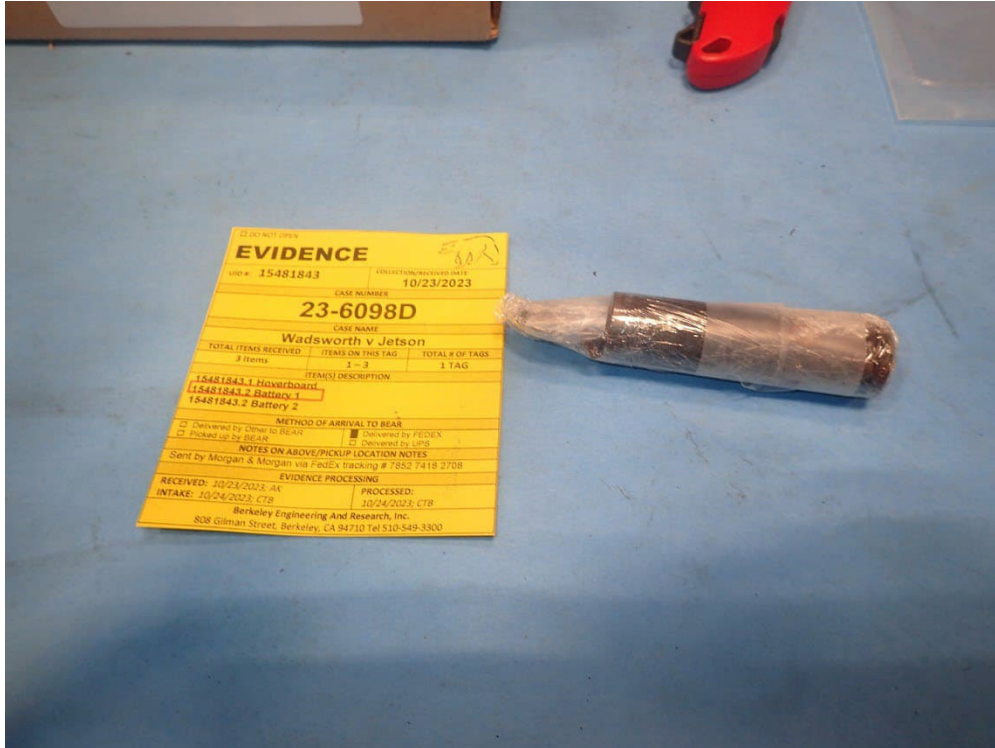


Figure 1: Artifacts recovered from the Wadsworth residential fire.



Figure 2: Remains of the subject hoverboard and its associated battery cells.

Examination of the remains of the two cylindrical 18650 battery cells revealed the battery cells were given designations battery 1 and battery 2, respectively. These battery cells were found next to the subject hoverboard and did not exhibit evidence of an electrical malfunction or failure, in the form of a bulged steel encasement nor evidence of arcing and shorting in the form of melting of the steel encasement can, as shown in **Figure 3** through **Figure 8**.



**Figure 3: Remains of 18650 battery cell designated battery 1.**



Figure 4: Side view of 18650 battery cell designated battery 1.



Figure 5: Top view of 18650 battery cell designated battery 1.

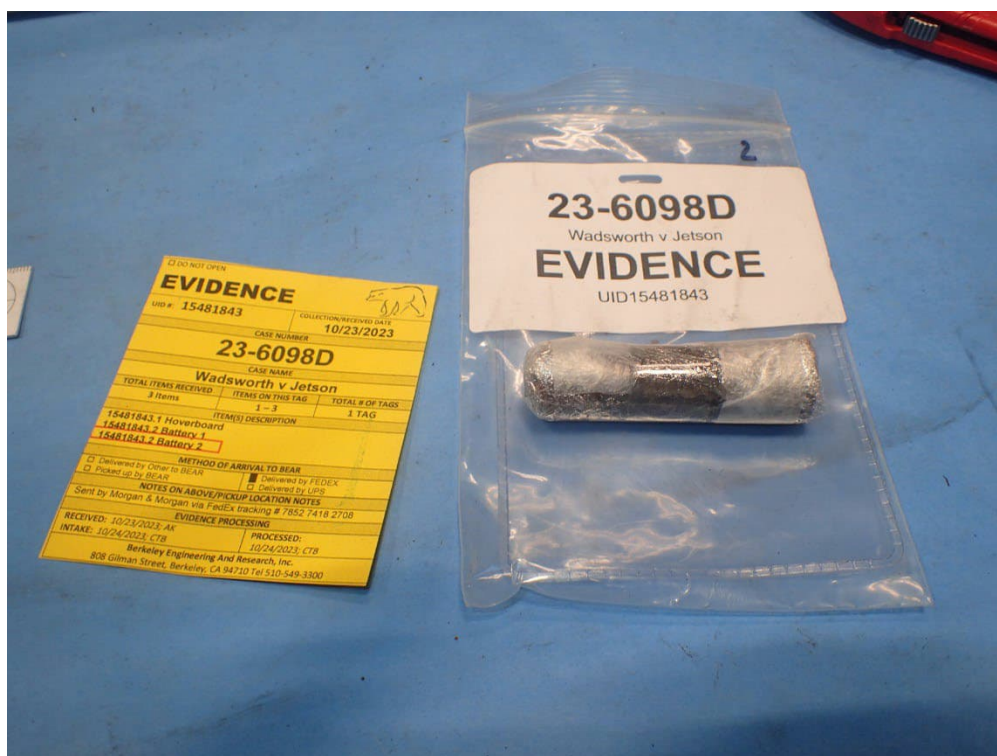
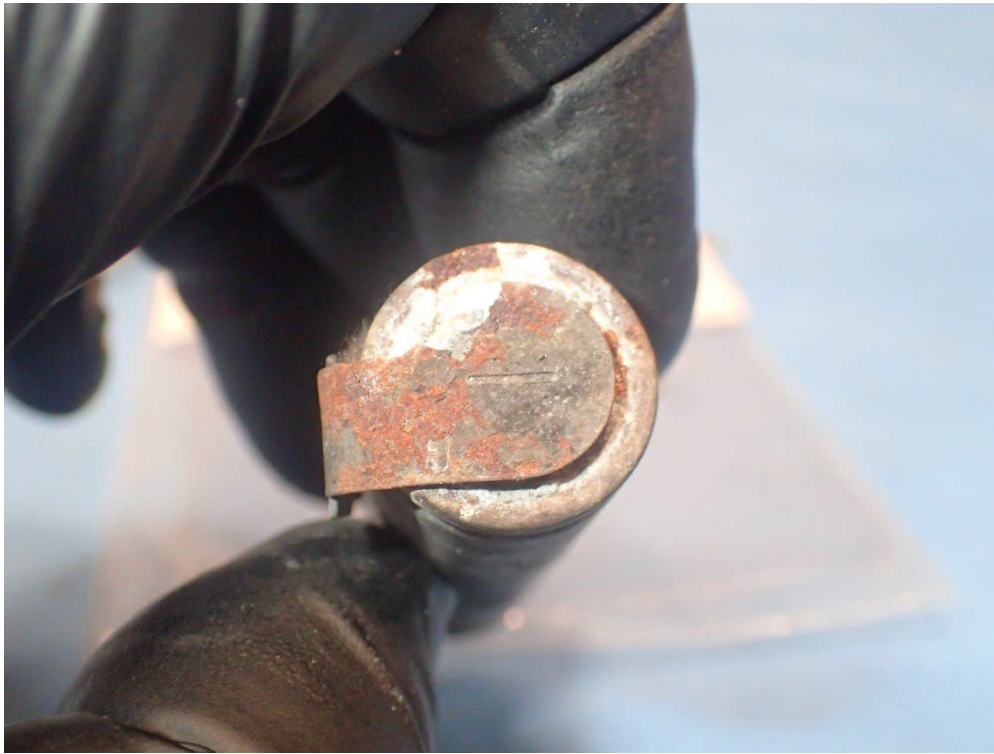


Figure 6: Remains of 18650 battery cell designated battery 1.



Figure 7: Side view of 18650 battery cell designated battery 2.



**Figure 8: Top view of 18650 battery cell designated battery 2.**

Examination of the artifacts continued with the remains of the subject hoverboard. The hoverboard sustained heat damage from the exterior, as opposed to the interior, because the melted casing for the interior of the hoverboard was not melted and the batteries and circuitry for the hoverboards were heat damaged but did not show evidence of bulging or melting, as shown in **Figure 9** and **Figure 12**. It is important to note that the carpeting, wiring insulation as well as the green plastic encasement were still intact. Examination of the hoverboard revealed that the main motor board and the two balancing boards were intact and exhibited no signs of electrical arcing and shorting in the form of melted copper as seen in **Figure 13** and **Figure 14**. Close examination of these X-Ray images revealed that the soldered electronic components of the hoverboard control system were not melted and remain intact. It is important to note that solder melts at 361°F and aluminum melts at 1,200°F, so if the fire started in the interior of the hoverboard the solder would have melted, but it did not. **Therefore, it is the opinion of S-E-A that the subject hoverboard, found in the area of origin identified by M.J. Schulz & Associates, was not the cause of the fire.**



**Figure 9: Top view of the subject Jetson Model Plasma hoverboard with undamaged wiring (Green Arrow)**



**Figure 10: Closeup view of the undamaged wiring.**



Figure 11: Underside of the subject Jetson Model Plasma showing the undamaged carpet.



Figure 12: Underside of the subject Jetson hoverboard showing the paper tag, tread on the tires as well as the green plastic cover.

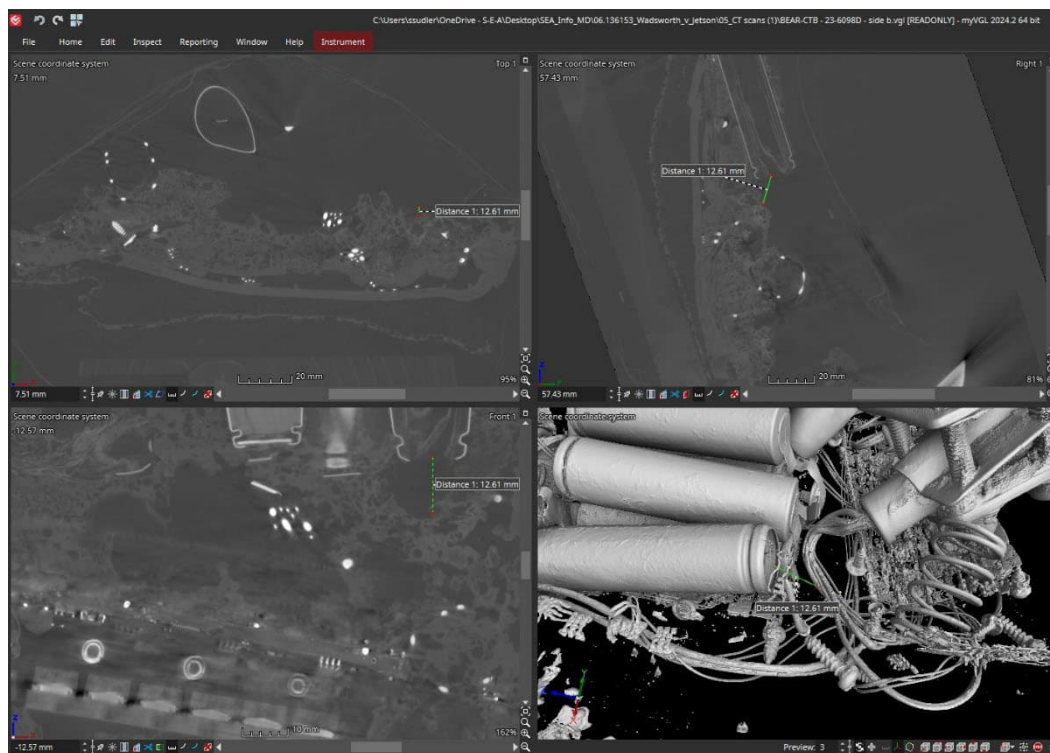


Figure 13: CT scan of the battery cells as well as the circuit boards with no melted solder.

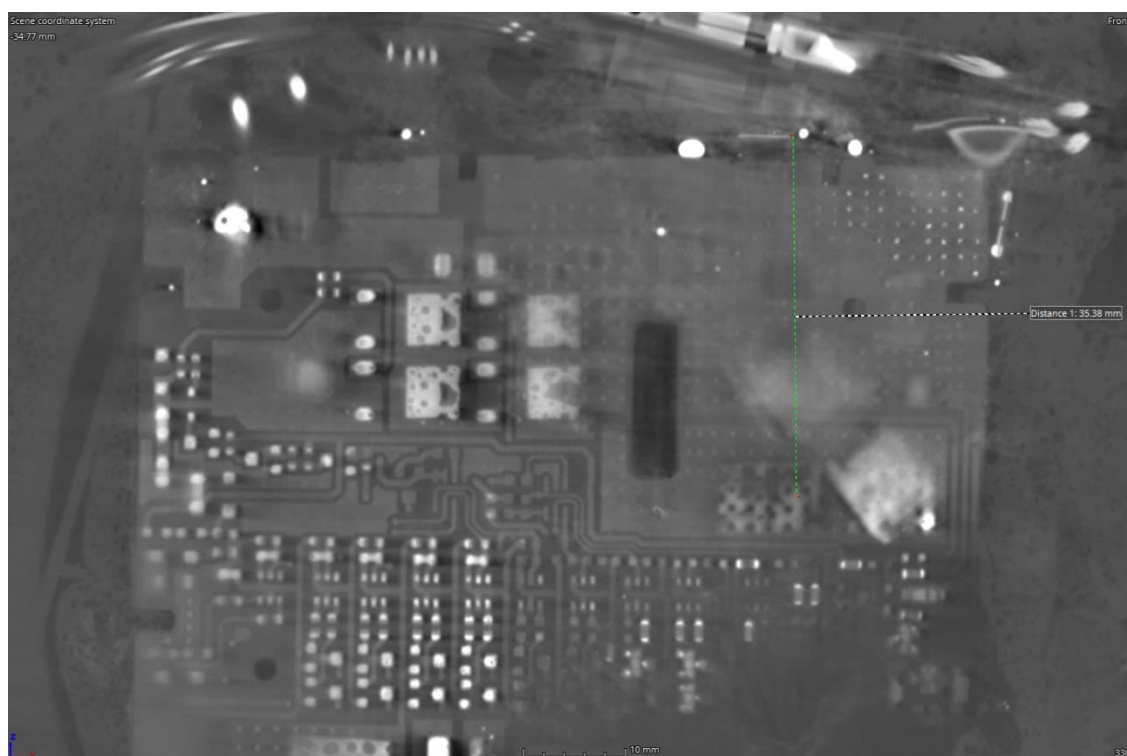


Figure 14: Closeup of the battery management system (BMS) for the subject Jetson hoverboard.

## IV. Research and Investigation

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### UL 2272 Safety Standard for Electrical Systems for Personal E-Mobility Devices

Underwriters Laboratories (UL) is an independent product safety certification organization that has been testing products and writing standards for safety since 1894. UL evaluates more than 19,000 types of products, components, materials, and systems annually with 20 billion UL Marks appearing on 66,000 manufacturers' products each year. UL's worldwide family of companies and network of service providers includes 68 laboratories, testing, and certification facilities serving customers in 102 countries.

Based on information obtained from the discovery material provided by McCoy Leavitt Laskey, LLC, the subject Jetson Model Plasma, as well as its electrical components are listed under Certification No. E48641, including the battery cells manufactured by Jiangxi Jiuding Power New Energy Technology Co. Ltd. This indicates that the UL 2272 Safety Standard for “Electrical Systems for Personal E-Mobility Devices” (UL 2272) is the standard to be used to investigate this particular product. UL 2272 covers the electrical drive train system including the battery system, other circuitry and electrical components for electric powered scooters and other devices to be referred to as personal e-mobility devices. Review of UL 2272 revealed that the lithium battery cells are subjected to a series of performance tests, as well as the battery cells being tested to the IEC 62133-2 standard, as seen in **Figure 15**. The performance tests are designed to subject the battery cells to mistreatment that they would be exposed to during normal use of the product. This testing is to ensure that there will not be a failure of the battery cells that could potentially cause a fire or injury. The performance tests include, but are not limited to the following:

- Overcharge Test
- Short-Circuit Test
- Over discharge Test
- Imbalanced Charging Test
- Crush Test
- Temperature Test



UL 1998, *Software in Programmable Components*

UL 2054, *Household and Commercial Batteries*

UL 2251, *Plugs, Receptacles, and Couplers for Electric Vehicles*

UL/ULC 2271, *Batteries for Use In Light Electric Vehicle (LEV) Applications*

UL/ULC 2580, *Batteries for Use in Electric Vehicles*

UL 2849, *Electrical Systems for eBikes*

UL 60730-1, *Automatic Electrical Controls for Household and Similar Use – Part 1: General Requirements*

UL 60950-1, *Information Technology Equipment – Safety – Part 1: General Requirements*

UL 62133-1, *Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes – Safety Requirements for Portable Sealed Secondary Cells, and for Batteries Made from Them, for Use in Portable Applications – Part 1: Nickel Systems*

UL 62133-2, *Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes – Safety Requirements for Portable Sealed Secondary Cells, and for Batteries Made from Them, for Use in Portable Applications – Part 2: Lithium Systems*

UL 62368-1, *Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements*

## 6 Glossary

- 6.1 For the purpose of this Standard the following definitions apply.
- 6.2 BATTERY – A generic term for one or more cells electrically connected in series and/or parallel with or without monitoring and protection circuitry for charging and discharging.
- 6.3 BATTERY PACK – Batteries that are ready for use in a personal e-mobility device, contained in a protective enclosure, with protective devices, with a battery management system, and monitoring circuitry and that may be removable by the user for charging separately from the device.
- 6.4 BATTERY SYSTEM – Battery system includes the battery, charger and monitoring and protection circuit for charging and discharging of the battery.
- 6.5 CAPACITY, RATED – The total number of ampere-hours that can be withdrawn from a fully charged battery at a specific discharge rate to a specific end-of-discharge voltage (EODV) at a specified temperature as declared by the manufacturer.
- 6.6 CASING – The container that directly encloses and confines the electrolyte, and electrodes of a cell.
- 6.7 CELL – The basic functional electrochemical unit (sometimes referred to as a battery) containing an electrode assembly, electrolyte, separators, casing, and terminals. It is a source of electrical energy by direct conversion of chemical energy.

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Figure 15: UL 2272 standard outlining the IEC 62133-2 testing the battery cells are subjected to for the Jetson hoverboard.



Once the lithium-ion battery cells meet the requirements of these and other tests, as shown in **Figure 16**, UL certifies the product. Therefore, for the lithium-ion battery cells to become damaged, as shown previously in Figure 4 through Figure 9, the cells must be subjected to abuse and misuse beyond the aforementioned testing, which includes being attacked by an external fire.

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**CERTIFICATE OF COMPLIANCE**

|                           |                  |
|---------------------------|------------------|
| <b>Certificate Number</b> | E486410          |
| <b>Report Reference</b>   | E486410-20190819 |
| <b>Issue Date</b>         | 2021-October-15  |

|                   |  |
|-------------------|--|
| <b>Issued to:</b> | JETSON ELECTRIC LLC<br>1 Rewe Street 2nd Floor<br>Brooklyn, NY 11211 USA |
|-------------------|--|

|   |  |
|---|--|
| <b>This certificate confirms that representative samples of</b> | ELECTRICAL SYSTEMS FOR PERSONAL E-MOBILITY DEVICES<br>See Addendum page for models |
|---|--|

Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.

|                                |   |
|--------------------------------|---|
| <b>Standard(s) for Safety:</b> | UL 2272, Electrical Systems for Personal E-Mobility Devices;<br>ANSI/UL-2272 - Electrical Systems for Personal E-Mobility Devices |
|--------------------------------|---|

|                                |   |
|--------------------------------|---|
| <b>Additional Information:</b> | See the UL Online Certifications Directory at <a href="https://iq.ulprospector.com">https://iq.ulprospector.com</a> for additional information. |
|--------------------------------|---|

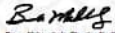
  


This Certificate of Compliance does not provide authorization to apply the UL Mark. Only the UL Follow-Up Services Procedure provides authorization to apply the UL Mark.

Only those products bearing the UL Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Certification Mark on the product.

  
Bruce Maheshwari, Director North American Certification Program  
UL LLC  
Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL. For questions, please contact a local UL Customer Service Representative at <http://ul.com/about/contact>



JETSON 0333

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**Figure 16: UL Certificate of Completion and Authorization to Apply UL Mark.**

Therefore, it is the opinion of S-E-A that the Jetson Model Plasma hoverboard was designed, functioned, and operated in accordance with all applicable standards, and that all battery cells adhered to the IEC 62133-2 testing and standards.



## International Electrotechnical Commission (IEC) 62133 - 2 - Safety Requirements for Portable Sealed Secondary Cells - Part 2: Lithium Systems - Internal Short Circuit Test

Based on research on the IEC website, it shows that the Jiangxi Jiuding Power New Energy Technology Co. Ltd. battery cells conformed to the IEC 62133-2 Safety Requirements for Portable Sealed Secondary Cells - Part 2: Lithium Systems. Review of this standard shows it is similar to the UL 1642 Standard for Lithium Batteries except that the IEC 62133-2 subjected the battery cell to an additional test - Design Evaluation - Forced internal short circuits in Section 7.3.9. The purpose of this particular test, and design evaluation, is to address any unlikely but potential manufacturing concerns with potential conductive material getting into the electrolytic roll, or if there is a concern with the separator used by the battery cell manufacturer for the electrolytic roll. This test first involves putting a piece of nickel inside of the cylindrical cell, as shown in **Figure 17** and then putting it back together.

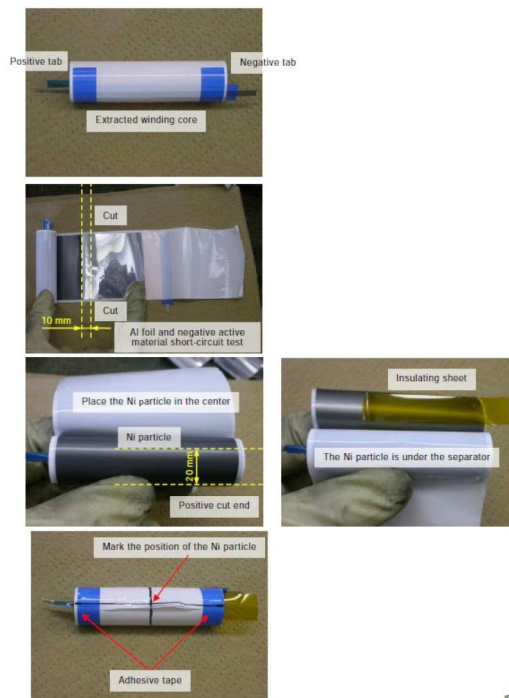
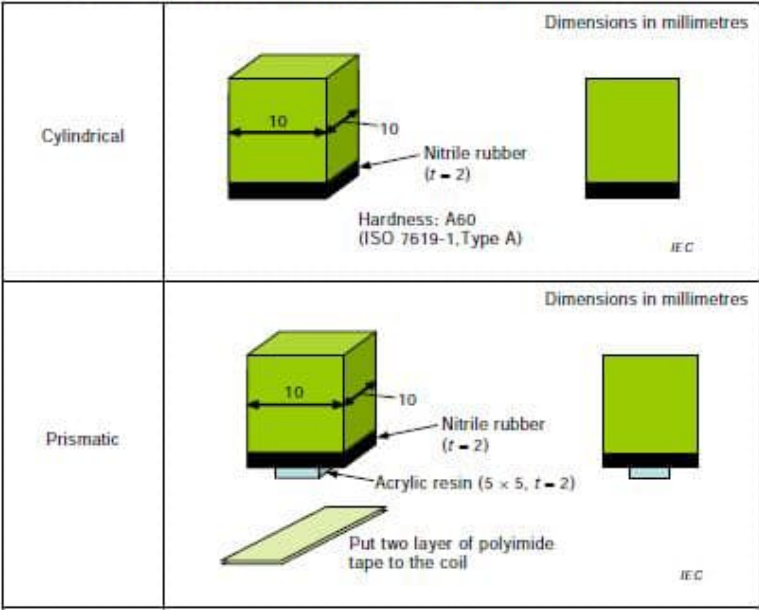


Figure A.6 – Disassembly of cylindrical cell

Figure 17: IEC internal short circuit test for a cylindrical cell.

The cell is then pressed using the test shown in **Figure 18**, by connecting a voltage and monitoring it for a 50-mV drop in voltage while pressing it with 800N of pressure for 30 seconds. The outcome of the test must not result in fire. Jiangxi Jiuding Power New Energy Technology Co. Ltd. has been testing its cells, both cylindrical and prismatic, since 2018 and passed the test that resulted in its IEC certification, as seen in **Figure 19**.

- ii) Internal short-circuit
- A Confirm that the winding core surface temperature is as defined in Table 5, and then start the test.
- B The bottom surface of the moving part of the press equipment (i.e. pressing jig) is made of nitrile rubber or acrylic resin, which is put on the 10 mm × 10 mm stainless steel shaft. Details of the pressing jigs are shown in Figure 2. The nitrile rubber bottom surface is for a cylindrical cell test. For a prismatic cell test, 5 mm × 5 mm (2 mm thickness) acrylic resin is put on the nitrile rubber.
- The fixture is moved down at a speed of 0,1 mm/s, monitoring the cell voltage. When a voltage drop caused by the internal short-circuit is detected, stop the descent immediately and keep the pressing jig in the position for 30 s, and then release the pressure. The voltage is monitored at a rate of more than 100 times per second. If the voltage drops more than 50 mV compared to the initial voltage, an internal short-circuit has been determined to have occurred. If the force of the press reaches 800 N for a cylindrical cell or 400 N for a prismatic cell before the 50 mV voltage drop, stop the descent immediately .



- c) Acceptance criteria
- No fire. Record the force when an internal short-circuit occurs if there was no fire.

**Figure 18: Second part of the IEC internal short circuit test.**



9/12/24, 4:48 PM

DK-78361-UL | IECEE Certificates

IEC

IECEE

IECEE

Log in

VALID

DK-78361-UL

CB Test Certificate  
2018-11-20

PRODUCT

Cylindrical Li-ion Cell

MANUFACTURER

Jiangxi Jiuding-Power New Energy Technology Co Ltd

RATINGS AND PRINCIPAL CHARACTERISTICS

INR18650P 2000mAh: 3.6V, 2000mAh INR18650P 2200mAh: 3.6V, 2200mAh INR18650P 2500mAh:  
3.6V, 2500mAh INR18650P 2600mAh: 3.6V, 2600mAh

TRADEMARK / BRAND

N/A

MODEL / TYPE REF.

INR18650P 2000mAh,INR18650P 2600mAh,INR18650P 2500mAh,INR18650P 2200mAh-(Model  
designation: INR18650P)

STANDARD(S) USED

IEC 62133:2012

NATIONAL DIFFERENCES


(Empty)

DATE OF ISSUE

2018-11-20

CERTIFICATE ISSUED BY

UL (Demko)  
Borupvang 5A, DK-DK-2750 Ballerup  
Denmark



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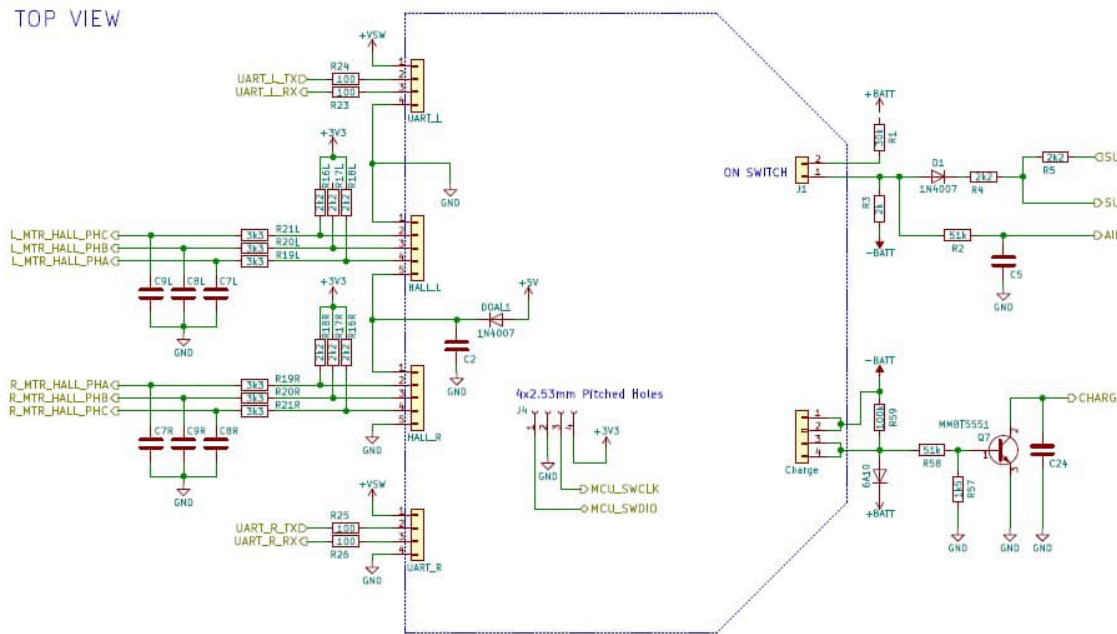
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Figure 19: Jiangxi Jiuding Power New Energy Technology Co. Ltd. Test and Certification for IEC 62133-2.

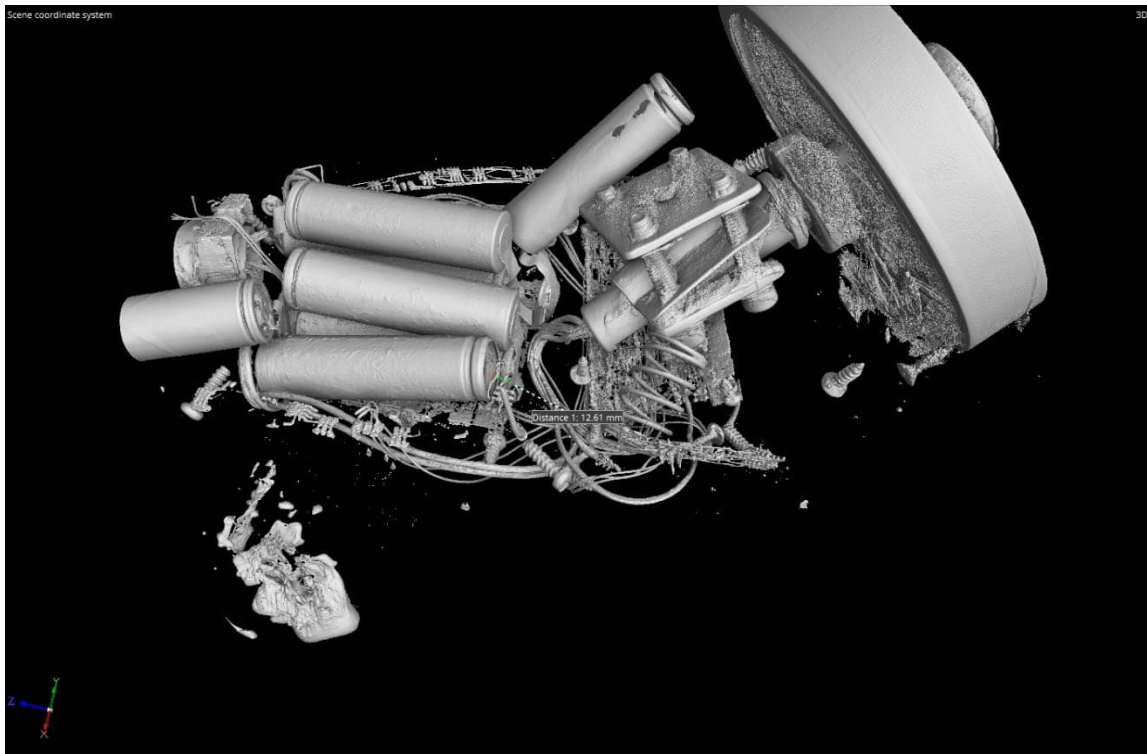
It has been purported by BEAR that the subject cells, identified as Cell 4 and Cell 10 in this matter, sustained a manufacturing defect that could result in an internal short circuit at approximately the same time that resulted in a failure that could cause a fire.



If there was an internal short circuit it would take time to develop, allowing the current interrupting device (CID) to activate and prevent any issue that could lead to a fire. For there to be an issue it must be an external short circuit capable of generating a current faster than the CID is able to respond to in time. However, because this is a closed loop electrical system, as seen in **Figure 20**, and the configuration of the battery pack does not allow an external short circuit to occur, as seen in **Figure 21**, the only way for the cells to sustain this type of damage is from an external thermal event such as a fire.



**Figure 20: Closed loop electrical system for hoverboard.**



**Figure 21: C.T. scan of the subject Jetson hoverboard showing no evidence of electrical arcing and shorting on wiring.**

Evaluation of the photographs from an exemplar Jetson Model Plasma hoverboard revealed that the electronic circuit boards as well as the battery pack were protected by a plastic enclosure. Close examination of the exemplar hoverboard also revealed that the battery cells were almost in contact with the balancing circuit board and the aluminum housing. According to NFPA 921, Aluminum melts at 1,220°F while identifiable temperatures in structural fires can reach temperatures of 1,900°F, as seen in **Figure 22**. It is important to note that physical examination and a review of the X-Rays associated with the balancing board revealed none of the electrical conductors, which melts at 1,981°F, exhibited visible evidence of electrical arcing and shorting in the form of melted copper, which would have occurred had the battery cells been the cause of this fire.

Table 6.2.8.2 Approximate Melting Temperatures of Common Materials

| Material                                | Melting Temperatures |           |
|---|----------------------|-----------|
|   | °C                   | °F        |
| Aluminum (alloys) <sup>a</sup>          | 566–650              | 1050–1200 |
| Aluminum <sup>b</sup>                   | 660                  | 1220      |
| Brass (red) <sup>a</sup>                | 996                  | 1825      |
| Brass (yellow) <sup>a</sup>             | 932                  | 1710      |
| Bronze (aluminum) <sup>a</sup>          | 982                  | 1800      |
| Cast iron (gray) <sup>b</sup>           | 1350–1400            | 2460–2550 |
| Cast iron (white) <sup>b</sup>          | 1050–1100            | 1920–2010 |
| Chromium <sup>b</sup>                   | 1845                 | 3350      |
| Copper <sup>b</sup>                     | 1082                 | 1981      |
| Fire brick (insulating) <sup>b</sup>    | 1638–1650            | 2980–3000 |
| Glass <sup>b</sup>                      | 593–1427             | 1100–2600 |
| Gold <sup>b</sup>                       | 1063                 | 1945      |
| Iron <sup>b</sup>                       | 1540                 | 2802      |
| Lead <sup>b</sup>                       | 327                  | 621       |
| Magnesium (AZ31B alloy) <sup>a</sup>    | 627                  | 1160      |
| Nickel <sup>b</sup>                     | 1455                 | 2651      |
| Paraffin <sup>b</sup>                   | 54                   | 129       |
| Plastics (thermo)                       |                      |           |
| ABS <sup>d</sup>                        | 88–125               | 190–257   |
| Acrylic <sup>d</sup>                    | 90–105               | 194–221   |
| Nylon <sup>d</sup>                      | 176–265              | 349–509   |
| Polyethylene <sup>d</sup>               | 122–135              | 251–275   |
| Polystyrene <sup>d</sup>                | 120–160              | 248–320   |
| Polyvinylchloride <sup>d</sup>          | 75–105               | 167–221   |
| Platinum <sup>b</sup>                   | 1773                 | 3224      |
| Porcelain <sup>b</sup>                  | 1550                 | 2820      |
| Pot metal <sup>c</sup>                  | 300–400              | 562–752   |
| Quartz (SiO <sub>2</sub> ) <sup>b</sup> | 1682–1700            | 3060–3090 |
| Silver <sup>b</sup>                     | 960                  | 1760      |
| Solder (63Sn/37Pb) <sup>f</sup>         | 183                  | 361       |
| Steel (carbon) <sup>a</sup>             | 1516                 | 2760      |
| Steel (stainless) <sup>a</sup>          | 1427                 | 2600      |
| Tin <sup>b</sup>                        | 232                  | 449       |
| Wax (paraffin) <sup>c</sup>             | 49–75                | 120–167   |
| White pot metal <sup>c</sup>            | 300–400              | 562–752   |
| Zinc <sup>b</sup>                       | 375                  | 707       |

<sup>a</sup>From Lide, ed., *Handbook of Chemistry and Physics*.  
<sup>b</sup>From Baumeister, Avallone, and Baumeister III, *Mark's Standard Handbook for Mechanical Engineers*.  
<sup>c</sup>From NFPA *Fire Protection Guide to Hazardous Materials*.  
<sup>d</sup>From McGraw-Hill, *Plastics Handbook*.  
<sup>e</sup>From Gieck and Gieck, *Engineering Formulas*.  
<sup>f</sup>From *Smithells Metals Reference Book*, 7<sup>th</sup> edition, Butterworth-Heinemann.

Figure 22: Melting temperatures of various metals and other items.

Therefore, it is the opinion of S-E-A that the subject Jetson Model Plasma hoverboard contained 18650 lithium-ion battery cells associated with the battery pack, manufactured by Jiangxi Jiuding Power New Energy Technology Co. Ltd., were designed, functioned, and operated in accordance with all applicable standards, and that this incident was not caused by an internal short circuit that would have resulted in a thermal runaway failure within any of the recovered subject battery cells.

Review and Evaluation of Berkeley Engineering and Research (BEAR) Report related to the Subject Fire using the Scientific Method

After reviewing the BEAR Report authored by Derek King, P.E. dated July 12, 2024, S-E-A again utilized the Scientific Method outlined in National Fire Protection Association (NFPA) 921, "Guide for Fire and Explosion Investigations" to evaluate the opinions proffered by ETP in their report, which are as follows:



- BEAR Opinion 2 & BEAR Opinion 3– Inspection and analysis of the subject board and cells indicates the ruptured cells were more likely caused by an internal short rather than external heating. Internal cell shorting can result in cell fires which is consistent with other expert findings of the fire origin at the subject board location.
- BEAR Opinion 1 and BEAR Opinion 4 – Careful and prudent manufacturers and distributors of consumer products should perform competent FMEAs or similar risk assessments to eliminate potential dangers associated with their products. It appears unlikely that Jetson performed a competent risk assessment for their subject hover board. The subject incident corresponds to the CPSC Safety Alert regarding the risk of hoverboard fires and leaving the board on the charger for extended periods of time.

The aforementioned hypothesis, or opinion, associated with the cause of this alleged battery fire incident will be evaluated using the Scientific Method, as suggested by the flow chart in NFPA 921 (**Figure 23**), utilizing all known and pertinent facts related to this matter, which include discovery documentation, deposition testimony, and joint evidence examinations of retained artifacts, without examining the actual subject incident battery cell.



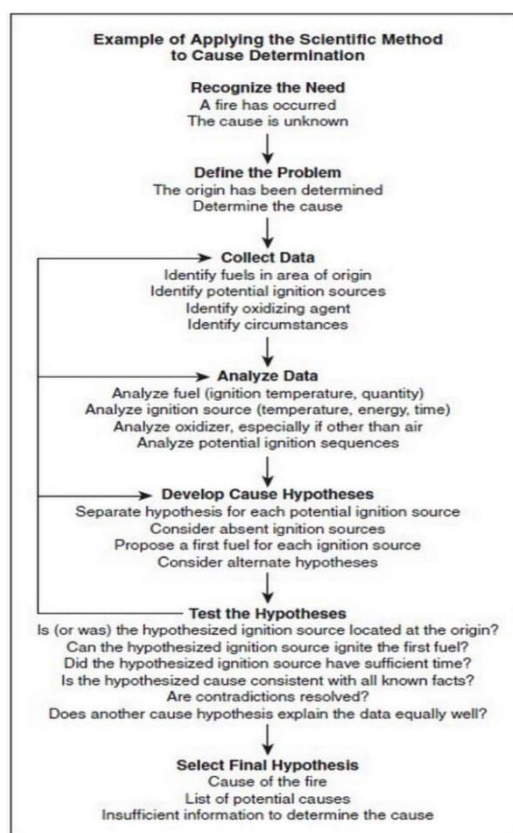


Figure 23: NFPA 921-199, shown as Figure 19.2.

Adhering to the Scientific Method is a safeguard against two common issues that can lead to erroneous opinions, and those issues, as defined in NFPA 921, are as follows:

- **Confirmation Bias** - Different hypothesis may be compatible with the same data. When using the scientific method, testing of hypothesis should be designed to disprove a hypothesis (i.e., falsification of the hypothesis), rather than relying only on confirming data that support the hypothesis. Confirmation bias occurs when the investigator relies exclusively on data that supports the hypothesis and fails to look for, ignores, or dismisses contradictory or non-supporting data. The same data may support alternative and even opposing hypotheses. The failure to consider alternative or opposing hypotheses, or prematurely discounting seemingly contradictory data without appropriate analysis and testing can result in incorrect conclusions.
- **Expectation Bias** - Expectation bias is a well-established phenomenon that occurs in scientific analysis when investigator(s) reach a premature conclusion without having

examined or considered all of the relevant data. Instead of collecting and examining all of the data in a logical and unbiased manner to reach a scientifically reliable conclusion, the investigator(s) uses the premature determination to dictate investigative processes, analyses, and, ultimately, conclusions, in a way that is not scientifically valid. The introduction of expectation bias into the investigation results in the use of only data that supports this previously formed conclusion and often results in the misrepresentation and/or the discarding of data that does not support the original opinion.

BEAR Opinion 2 & BEAR Opinion 3— Regarding the subject hover board and the cells having an internal short capable of causing this fire as opposed to an external fire attacking the unit.

These opinions proffered by BEAR suggests that the fire at the Wadsworth residence was caused by an internal failure of Cell 4 and Cell 10. It is important to note that Cell 4 and Cell 10 were recovered with the cell casings still attached to the subject hoverboard and adjacent to the circuit boards for the subject hoverboard. In addition, the battery cell for Cell 4 and Cell 10 are rated at 3.7-VDC, 2.5Ah, and has a power rating of 9.0Wh. Close examination of the C.T. scan data of the subject Jetson Model Plasma hoverboard revealed that it was not plugged in at the time of the fire as nothing is attached to the power port as shown in Figure 24 and Figure 25. Therefore, the maximum power for Cell 4 and Cell 10 is 9.0Wh for each cell. According to Heat Transfer: A Practical Guide the amount of heat transfer is equal to  $Q = mC\Delta T$ , where mass is in kilograms and the specific heat for an 18650 lithium-ion battery cell is approximately 900 J/kg°C with Q being 9.0Wh and the mass being 0.044kg. Knowing the internal resistance of the battery cell is typically 50mΩ and  $P = I^2R$ , current (I) one can calculate the battery fault current from  $P = I^2R$  with  $I_{\text{fault}} = \sqrt{P/R}$ , which is 13.42-Ampers. With the discharge rate of 2.5Ah the fault current can be sustained for 11.18 minutes. Therefore, with  $Q = 9.0\text{WH}$  or 32,400 Watts in one second, it would take at least 10 seconds to catch paper on fire. Paper ignites at approximately 220°C, according to the Ignition Handbook. Therefore, the amount of power would be 3,240-Watts. Utilizing the Heat Transfer formula  $T_f = (Q/mC) + 25^\circ\text{C}$ , which give a temperature of 106.81°C. It is important to note that this temperature is less than the temperature that was achieved by the multiple internal short circuit (ISC) tests conducted by the NREL/NASA testing as shown in **Figure 26** and **Figure 27**. This is important because according to NFPA 921, there needs to be at least 30-Watts of power to create a fire.



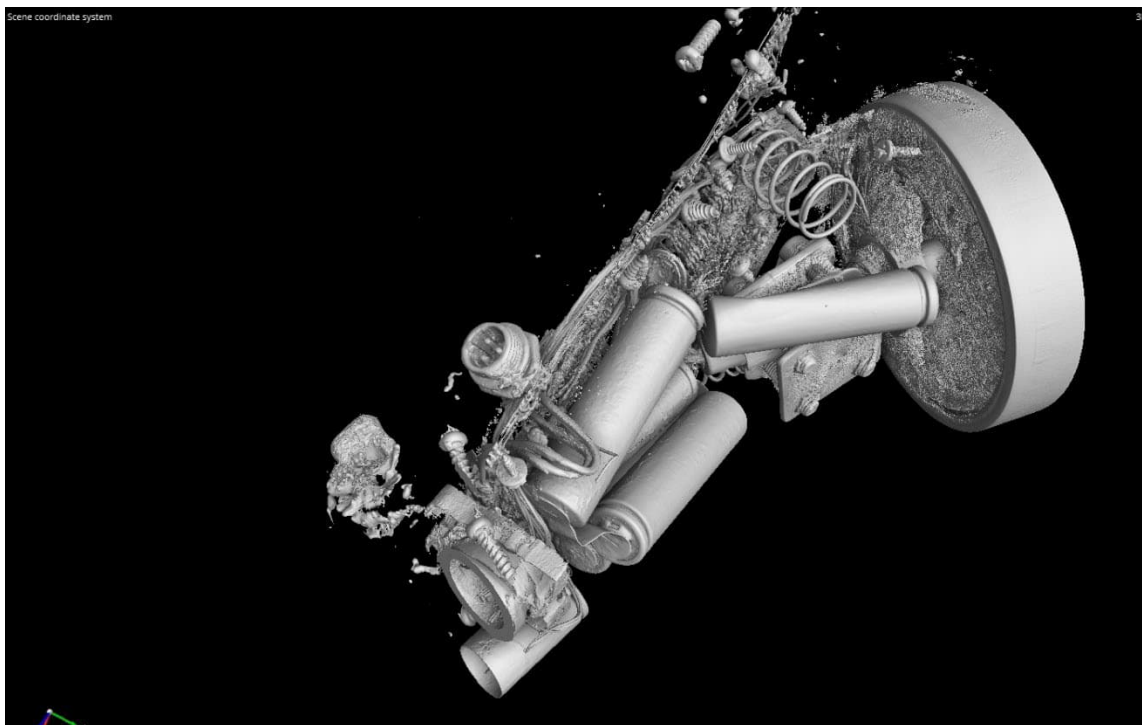


Figure 24: C.T. scan of the subject Jetson hoverboard showing the power port connector.

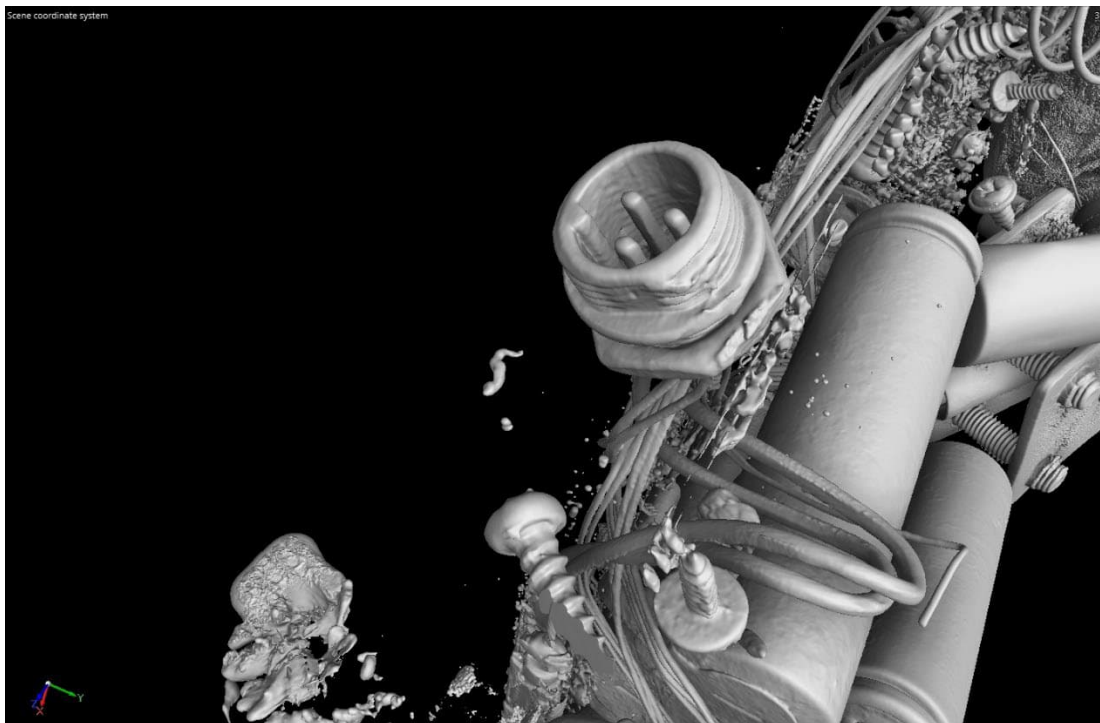


Figure 25: C.T. scan of the subject Jetson hoverboard showing the closeup of power port connector.

## ISC Implantation – Active to Active



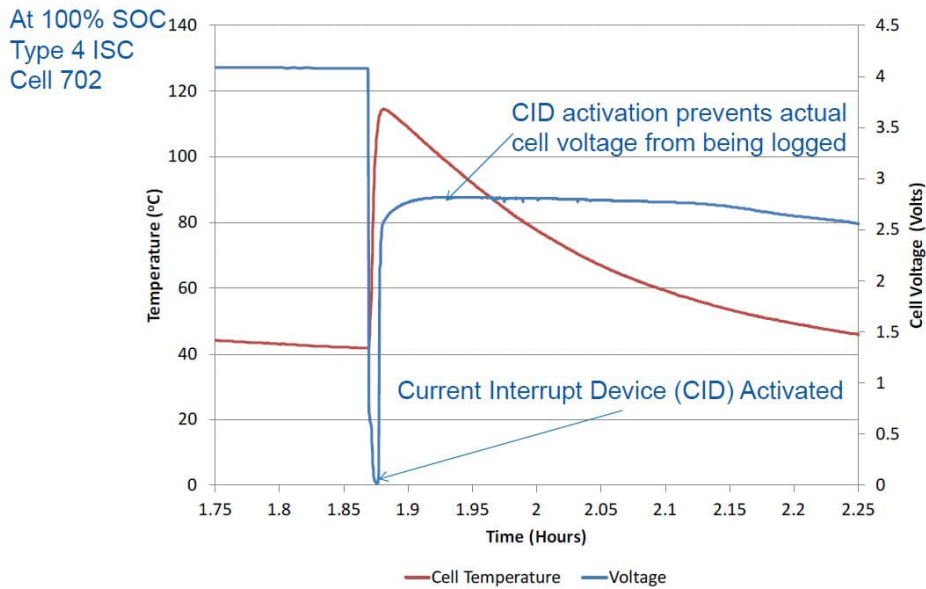
Photo Credits: Mark Shoesmith, E-One Moli

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Figure 26: Image from NREL/NASA test setup for ISC testing.

## 2nd Round – Foil to Foil ISC Activation



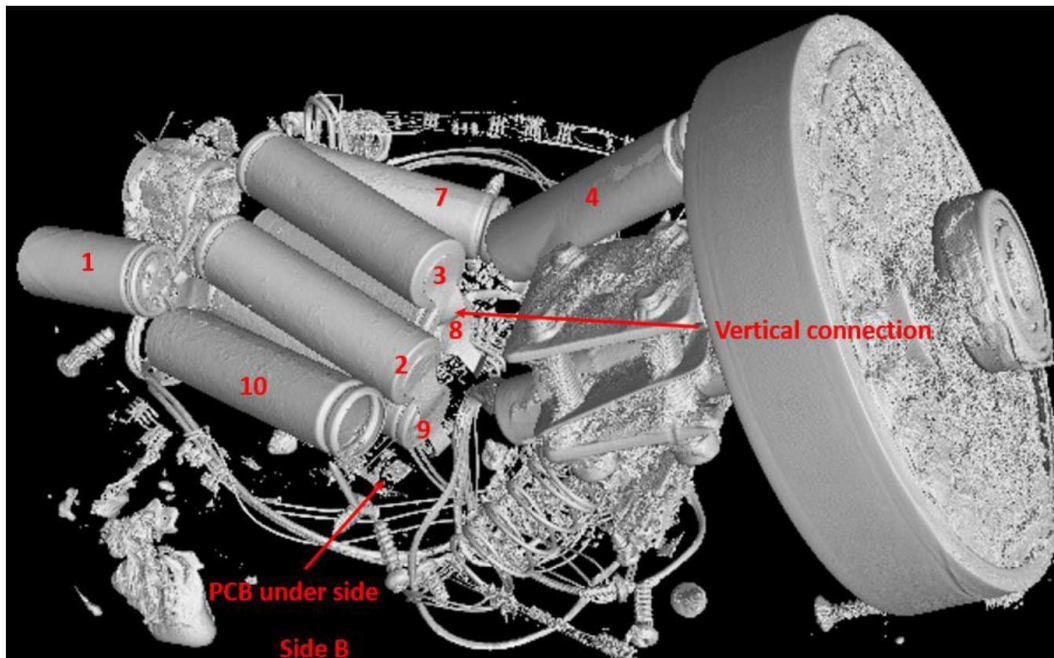
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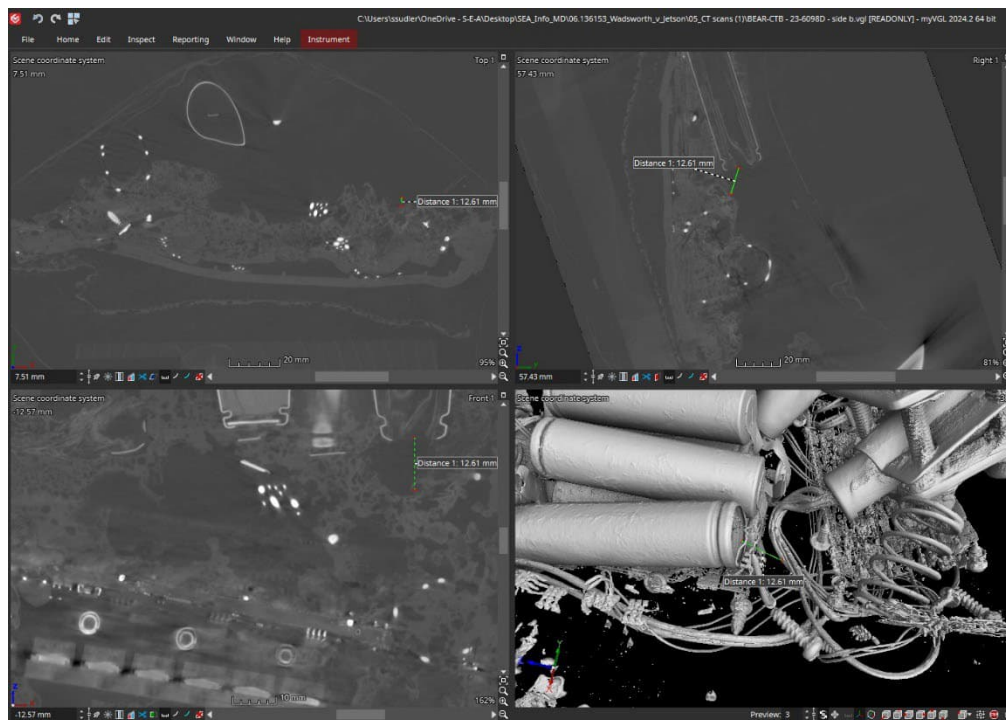
Figure 27: Image of results from NREL/NASA test setup for a Lithium-Ion 18650 battery.



Therefore, the battery only having had 9.0-Watts of power is not enough energy to cause the subject fire, as seen in **Figure 28** through **Figure 30**.



*Figure 9: An example of using CT scan data to identify evidence cells' original positions.*  
**Figure 28: Image from the BEAR report dated July 12, 2024 showing battery cell identifiers.**



**Figure 29: C.T. scan showing distance from Cell 10 from energized cables.**



**Figure 30: Remains of subject Jetson hoverboard showing distance from Battery cell 10 (Red Arrow) to the colored insulated wiring.**

**Therefore, it is the opinion of S-E-A that the subject 18650 lithium-ion battery cells identified by BEAR, as Cell 4 and Cell 10, do not have enough energy to cause this fire as the Jetson Model Plasma hoverboard was not plugged in at the time of the incident, which invalidates the BEAR opinion that an internal short circuit in batteries Cell 4 and Cell 10 caused this fire.**

BEAR Opinion 1 and BEAR Opinion 4 – Regarding Failure Mode and Effect Analysis (FMEA) and the Consumer Product Safety Commission Safety Alert Failure Mode and Effect Analysis (FMEA) is a tool used by various industries to determine what failure modes exist in a process, product, or design, and based on the FMEA there are improvements that had to be made to ensure a safe product is manufactured. Mr. Sudler utilized this tool, amongst others, as a Certified Lean Six Sigma Black Belt ensuring that the principles of Measure, Analyze, Improve and Control (MAIC) were adhered to during the process. The result of such a process can be found in the failure modes listed in UL 1642, shown in the UL – Lithium-ion Batteries Hazards diagram (**Figure 31**), and IEC 62133 standards that Jiangxi Jiuding Power New Energy Technology Co. Ltd. adhered to as expressed with their certification previously shown in Figure 12.

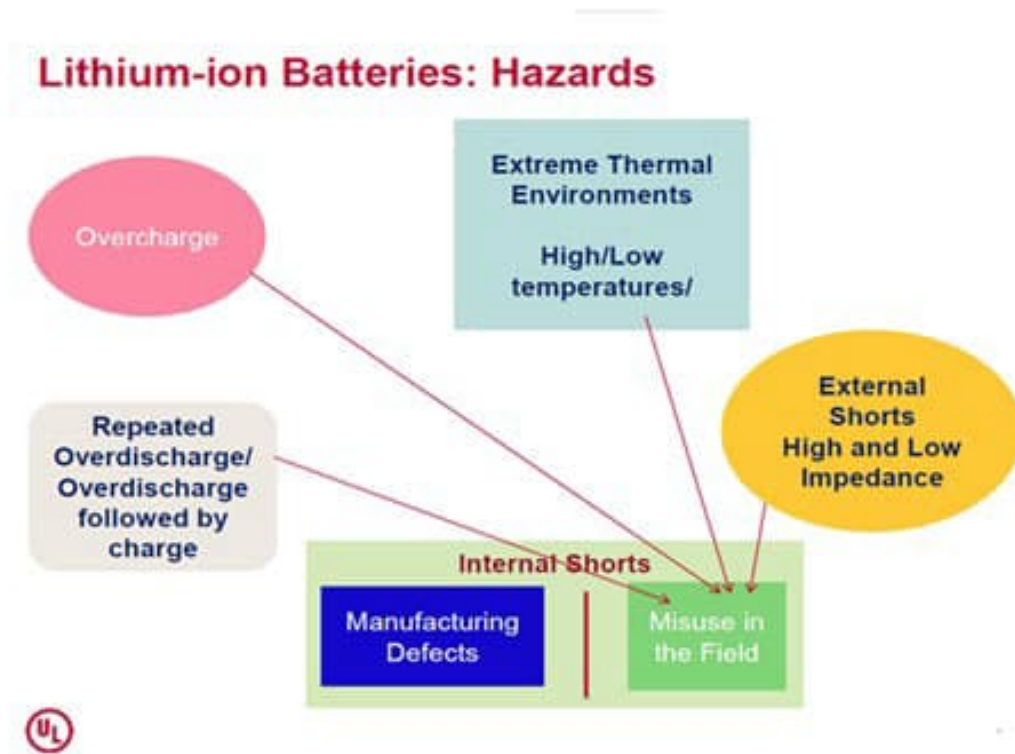


Figure 31: UL Listed Lithium-ion battery hazards

The potential Jiangxi Jiuding Power New Energy Technology Co. Ltd. failures outlined in the Berkeley Engineering and Research (BEAR) report dated July 12, 2024, are addressed by and confirmed by their UL and IEC actual testing and certifications. In addition, UL 2272 Safety Standard for Electrical Systems for Personal E-Mobility Devices reveals that the Jetson Model Plasma hoverboard was tested and certified while utilizing various FMEA standards, as shown in **Figure 32**. Review and evaluation of the CPSC Safety Alert mentioned in the BEAR report indicate it was released before the creation of UL 2272 that occurred November 1, 2016, which the Jetson Model Plasma was tested and certified to by UL. The CPSC Safety Alert is not relevant to analysis of the Wadsworth residential fire.

APRIL 19, 2024

ANSI/CAN/UL 2272

9

IEC 60812, *Analysis Techniques for System Reliability – Procedure for Failure Mode and Effects Analysis (FMEA)*

IEC 61025, *Fault Tree Analysis (FTA)*

IEC 61508-1, *Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems – Part 1: General Requirements*

ISO 6469-1, *Electrically Propelled Road Vehicles – Safety Specifications – Part 1: Rechargeable Energy Storage System (RESS)*

ISO 7010, *Graphical Symbols – Safety Colours and Safety Signs – Registered Safety Signs*

MIL-STD-1629A, *Procedures for Performing a Failure Mode, Effects, and Criticality Analysis*

SAE J1739, *Potential Failure Mode and Effects Analysis in Design (Design FMEA), Potential Failure Mode and Effects Analysis in Manufacturing and Assembly Processes (Process FMEA)*

UL 50E, *Enclosures for Electrical Equipment, Environmental Considerations*

UL 94, *Tests for Flammability of Plastic Materials for Parts in Devices and Appliances*

UL 157, *Gasket and Seals*

UL 746B, *Polymeric Materials – Long Term Property Evaluations*

UL 746C, *Polymeric Materials – Use in Electrical Equipment Evaluations*

UL 810A, *Electrochemical Capacitors*

UL 840, *Insulation Coordination Including Clearances and Creepage Distances For Electrical Equipment*

UL 991, *Tests for Safety-Related Controls Employing Solid-State Devices*

UL 969, *Marking and Labeling Systems*

UL 1004-1, *Rotating Electrical Machines – General Requirements*

UL 1004-2, *Impedance Protected Motors*

UL 1004-3, *Thermally Protected Motors*

UL 1004-7, *Electronically Protected Motors*

UL 1012, *Power Units other than Class 2*

UL 1310, *Class 2 Power Units*

UL 1642, *Lithium Batteries*

UL 1989, *Valve Regulated or Vented Batteries with Aqueous Electrolytes*

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Figure 32: UL 2272 standard outlining the FMEA standards used to consider testing the battery cells that are subjected to for the Jetson hoverboard.



Therefore, it is the opinion of S-E-A that manufacturers of products, such as Jiangxi Jiuding Power New Energy Technology Co. Ltd., have and continue to utilize the UL and IEC testing shown in the results of those respective test reports as its tool to be a practical FMEA as it addresses all known and potential failure modes outlined in the UL, IEC, and other applicable standards that are utilized by other lithium-ion battery manufacturers. It is further the opinion of S-E-A that the CPSC Safety Alert was not related to the subject Jetson Model Plasma and is therefore not pertinent to the investigation of the Wadsworth fire.



## Appendices

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### Samuel G. Sudler III, P.E., IntPE, DFE, F.NSPE, C.F.E.I. Credentials

1. Samuel G. Sudler III, P.E., IntPE, DFE, F.NSPE, C.F.E.I. CV
2. Samuel G. Sudler III, P.E., IntPE, DFE, F.NSPE, C.F.E.I. Testimony Log
3. Samuel G. Sudler III, P.E., IntPE, DFE, F.NSPE, C.F.E.I. Billable Rate Disclosure

### List of Referenced Material

1. American National Standards Institute (ANSI)/National Fire Protection Association (NFPA) 70E – Standard for Electrical Safety Requirements for Employee Workplaces, 2015 Edition
2. UL 1642 Safety Standard for “Lithium Batteries”
3. UL 2054 Safety Standard for “Household and Commercial Batteries”
4. IEC 62133-2 Secondary cells and batteries containing alkaline and other non-acid electrolytes - Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications - Part 2: Lithium Systems
5. International Classification Standard (ICS) 29.220.01 – National Standard of the People’s Republic of China – GB/T 18287-2000 – General specification of lithium-ion battery for cellular phone
6. ICS 29.220.01 – National Standard of the People’s Republic of China – GB/T 18287-2013 General specification of lithium-ion cells and batteries for mobile phone.
7. Universal Serial Bus (USB) Specification, Revision 2.0, April 27, 2000
8. National Fire Protection Association (NFPA) 921, “Guide for Fire and Explosion Investigations,” 2014 and 2017 Editions





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[ssudler@SEAlimited.com](mailto:ssudler@SEAlimited.com)

**Education**

*University of Pittsburgh*

*Pittsburgh, Pennsylvania*

Bachelor of Science in Electrical Engineering

**Experience**

**Senior Electrical Engineer**  
*SEA, Ltd.*

**2008 to Present**  
*Glen Burnie, Maryland*

**Senior Electrical Engineer**  
*SEA, Ltd.*

**2007 to 2008**  
*Elk Grove, Illinois*

**Electrical Engineer**  
*SEA, Ltd.*

**2002 to 2007**  
*Elk Grove, Illinois*

Investigate electrical faults and malfunctions, particularly those suspected of causing a fire, equipment damage, or electrocution. Reconstruct accidents to determine the mode, sequence, and/or component of failure resulting in the damage to equipment or injury to individuals. Analyze various types of electrical power equipment (i.e., transformers, circuit breakers, power lines, commercial and residential electrical systems, etc.) and appliances on-site and/or in the laboratory to determine the cause or result of an incident (i.e., fire, equipment damage, or personal injury). Conduct tests to determine the reliability of products.

**Senior Process Engineer**  
*Pilkington N.A., Inc.*

**1999 to 2002**  
*Ottawa, Illinois*

Responsible for reviewing main areas of loss in the wareroom process, and through the use of Six Sigma Measure, Analyze, Improve, and Check (MAIC) process, identify and implement changes to reduce areas of lost production. Installed and commissioned Focus Automation Glass digital camera inspection systems, which were programmed to automatically identify and reject defective glass, based on dimensional and cutting quality specifications. Conducted potential Failure Mode and Effect Analysis (FMEA) for all electrical equipment and control systems of the wareroom. Database Administrator (DBA) responsible for designing efficient queries, making database design changes, designing database maintenance routines, maintaining existing and designing new database loading programs for all production databases.

Professional Resume

Samuel G. Sudler, III, P.E., IntPE, DFE, F.NSPE, CFEI, CVFI (11/2023)

Page 2

Created various C programs for all production databases. Visual Basic (VB) applications and modified VB Human Machine Interface (HMI) programs to generate statistical process control (SPC) limit alarms that improved the manufacturing efficiency, improved quality, and reduced time to produce customer orders.

### **Senior Electrical Engineer**

**1998 to 1999**

*Pilkington N.A., Inc.*

*Ottawa, Illinois*

Recommended, purchased, and installed electrical equipment and software to increase reliability and improve system performance. Responsible for maintaining and ensuring the integrity of systems and equipment in the wareroom, which consisted of a Linux computer system, Texas Instruments and Reliance Programmable Logic Controllers (PLC), AC/servo drive control systems, ABB IRB 6000 robot servo control systems and robot programming. Directed the electrical staff in troubleshooting, repairing, or installing electrical equipment. Reviewed maintenance/engineering projects and work orders, oversaw and coordinated maintenance activities to ensure that maintenance resources were effectively utilized to ensure the facility met production targets.

### **Electrical Maintenance Supervisor**

**1996 to 1998**

*Birmingham Steel Corporation*

*Kankakee, Illinois*

Responsible for design, purchase, installation, and maintenance of electrical equipment in the Rolling Mill and Shipping Departments for both the Kankakee and Joliet plants. Audited the Asea Brown Broveri (ABB) control systems for five Birmingham Steel plants for the Executive Vice President. Responsible for electrical maintenance budget, totaling \$500,000. Supervised a team of one technician, one electrical lead man, and eight electricians. Maintained the 24 KV substation that provided power to the Kankakee facility, which consisted of two 5000 KVA transformers, bus bar integrity, and battery backup system for emergency medium-voltage switcher operation. Responsible for installing, maintaining, modifying, and troubleshooting various equipment, such as Human Machine Interfaces (HMI), Siemens/Allen-Bradley/ABB Programmable Logic Controller (PLC) programs, AC/DC/servo drive control systems, and configuration of the vector control AC drives for the 1000 HP motors. Designed, installed, reprogrammed, and commissioned the electrical equipment and control system for Danieli Tying machines at the Joliet facility.

### **Electrical Engineer**

**1995 to 1996**

*Beta Steel Corporation*

*Portage, Indiana*

Served as a member of the commissioning team, making recommendations and decisions concerning the design, operation, and reliability of Melt Shop equipment. Responsible for the installation, commissioning, testing, and maintenance of all electrical equipment installed during the commissioning phase. Electrical equipment consisted of medium voltage switchgear, Siemens and GE PLCs and transformers, and configuring overcurrent and short-circuit thyronic protective devices for motors up to 1750 HP.

### **Electrical Maintenance Planner**

**1994 to 1995**

*Weirton Steel Corporation*

*Weirton, West Virginia*

Engineered electrical projects and made recommendations to either improve, repair, or replace equipment and/or modify the method of operation. Assisted the Senior Electrical Supervisor in identifying and troubleshooting electrical equipment. Supervised the coke and iron preventative maintenance program. Assisted the Manager of Corporate Recruiting and Employee Development in evaluation of potential candidates for employment.

Professional Resume  
Samuel G. Sudler, III, P.E., IntPE, DFE, F.NSPE, CFEI, CVFI (11/2023)

Page 3

## **Electrical Engineering Co-op Student**

**1990 to 1992**

*West Penn Power*

*Greensburg, Pennsylvania*

Provided assistance to the Engineering Supervisor in an effort to increase knowledge in the field of Electrical Engineering. Improved service reliability by implementing fuse correlation and Radial Distribution Feeder Analyses Program. Increased the power factor of the 138 KV and 12 KV substation transformers by installing capacitors via 12 KV circuits. Updated and developed blueprints from existing circuit prints.

## **Professional Registration**

State of Alabama, License No. 29059  
State of Arkansas, Registration No. 13533  
State of Arizona, Registration No. 43391  
State of California, Registration No. 18451  
State of Colorado, License No. PE-39550  
State of Connecticut, License No. PEN 0026215  
State of Delaware, License No. 13902  
District of Columbia, License No. PE905017  
State of Florida, License No. 60538  
State of Georgia, Registration No. PE029011  
State of Idaho, License No. P-18222  
State of Illinois, License No. 062055428  
State of Indiana, Registration No. PE10302104  
State of Iowa, License No. 18739  
State of Kansas, License No. 17983  
Commonwealth of Kentucky, License No. 25623  
State of Louisiana, License No. PE.0031153  
State of Maine, License No. 11535  
State of Maryland, Registration No. 29419  
Commonwealth of Massachusetts, License No. 47729  
State of Michigan, License No. 6201050208  
State of Minnesota, License No. 42968  
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State of Montana, License No. 18325  
State of Nebraska, License No. 12368  
State of Nevada, License No. 024559  
State of New Hampshire, License No. 12347  
State of New Mexico, License No. 24266  
State of New York, License No. 16-082156  
State of North Carolina, License No. 033641  
State of North Dakota, Registration No. PE-5936  
State of Ohio, Registration No. E-68433  
State of Oklahoma, License No. 29478  
State of Oregon, Registration No. 80397PE  
Commonwealth of Pennsylvania, Registration No. PE075136  
State of Rhode Island, Registration No. 11013  
State of South Carolina, License No. 26056  
State of South Dakota, Registration No. 9454  
State of Tennessee, Registration No. 111920

State of Texas, License No. 126323  
State of Utah, Registration No. 10339520-2202  
State of Vermont, License No. 018.0129541  
Commonwealth of Virginia, License No. 040441  
State of Washington, Registration No. 44330  
State of West Virginia, Registration No. 22364  
State of Wisconsin, Registration No. 36081-006  
State of Wyoming, Registration No. 16066

### **International Professional Registration**

Registered International Professional Engineer (IntPE) in the disciplines of Electrical Engineering and the specialty practice areas of Forensic Engineering Studies, by the United States Council for International Engineering Practice (USCIEP) (A Participating International Registry Member of the Asian-Pacific Economic Cooperation (APEC) Engineer Coordinating Committee and the Engineers Mobility Forum (EMF) International Register Coordinating Committee), International Registration No. IR157

### **Certifications**

Board Certified Diplomate in Forensic Engineering by the National Academy of Forensic Engineers in accord with the guidelines of the Council of Engineering Specialty Boards (CESB)  
Certified Fire and Explosion Investigator (CFEI)  
Certified Vehicle Fire Investigator (CVFI)  
Certified Model Law Engineer (MLE) by National Council of Examiners for Engineers and Surveyors (NCEES)  
Certified Lean Six Sigma Black Belt by Six Sigma Qualtec, Inc.

### **Standards Technical Committees**

Member of the American National Standards Institute (ANSI)/Underwriters Laboratories (UL) Technical Committee (TC) 1642, formerly known as Standards Technical Panel (STP) 1642, *Lithium, Household and Commercial Batteries*, that is responsible for maintaining the following UL Safety Standards:

- UL 1642, Lithium Batteries
- UL 2054, Household and Commercial Batteries
- UL 60086-4, Primary Batteries-Part 4: Safety of Lithium Batteries
- UL 62133, Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes - Safety Requirements for Portable Sealed Secondary Cells, and for Batteries Made From Them, for Use in Portable Applications
- UL 62133-1, Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes - Safety Requirements for Portable Sealed Secondary Cells, and for Batteries Made From Them, for Use in Portable Applications - Part 1: Nickel Systems
- UL 62133-2, Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes - Safety Requirements for Portable Sealed Secondary Cells, and for Batteries Made From Them, for Use in Portable Applications - Part 2: Lithium Systems

Member of the ANSI/UL TC 2595 – *General Requirements for Battery-Powered Appliances*, that is responsible for maintaining the following UL Safety Standards:

- UL 2595, General Requirements for Battery-Powered Appliances

Member of the ANSI/UL TC 2580 – *Batteries For Use in Electric Vehicles*, that is responsible for maintaining the following UL Safety Standards:

- UL 2271, Standard for Batteries for Use in Light Electric Vehicle (LEV) Applications
- UL 2580, Standard for Batteries for Use in Electric Vehicles

Member of the ANSI/UL TC 2202 – *Electric Vehicle Charging System Equipment*, that is responsible for maintaining the following UL Safety Standards:

- UL 2202, Standard for Electric Vehicle (EV) Charging System Equipment
- UL 2594, Standard for Electric Vehicle Supply Equipment

Member of the ANSI/UL TC 9540 – *Energy Storage Systems and Equipment*, that is responsible for maintaining the following UL Safety Standards:

- UL 9540, Standard for Energy Storage Systems and Equipment
- UL 9540A, Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems

Member of the UL TC 3001 – *Distributed Energy Generation And Storage Systems*, that is responsible for maintaining the following UL Safety Standards:

- UL 3001, Standard for Distributed Energy Generation And Storage Systems

Member of the ANSI/UL TC 6200 – *Controls For Stationary Engine Driven Assemblies*, that is responsible for maintaining the following UL Safety Standards:

- UL 6200, Standard for Controllers for Use in Power Production

Member of the ANSI/UL TC 2231 – *Personnel Protection Systems For EV Supply Circuits*, that is responsible for maintaining the following UL Safety Standards:

- UL 2231-1, Standard for Safety for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: General Requirements
- UL 2231-2, Standard for Safety for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems

Member of the ANSI/UL TC 1973 – *Batteries Used in Stationary And In Light Electric Rail*, that is responsible for maintaining the following UL Safety Standards:

- UL 1973, Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications
- UL 1989, Standard for Stationary Batteries

Member of the ANSI/UL TC 5840 – *Battery Powered Ground Support Equipment*, that is responsible for maintaining the following UL Safety Standards:

- UL 5840, Standard for Electrical Systems of Battery Powered Aviation Ground Support Equipment

Member of the ANSI/UL TC 2591 – *Battery Cell Separators*, that is responsible for maintaining the following UL Safety Standard:

- UL 2591, Outline of Investigation for Battery Cell Separators

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 Samuel G. Sudler, III, P.E., IntPE, DFE, F.NSPE, CFEI, CVFI (11/2023)

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Member of the ANSI/UL TC 1012 – *Battery Chargers*, that is responsible for maintaining the following UL Safety Standards:

- UL 1012, Standard for Power Units Other Than Class 2
- UL 1236, Standard for Battery Chargers for Charging Engine-Starter Batteries
- UL 1564, Standard for Industrial Battery Chargers
- UL 60335-2-29, Household and Similar Electrical Appliances, Part 2-29: Particular Requirements for Battery Chargers

Member of the ANSI/UL TC 110 – *Mobile Phones*, that is responsible for maintaining the following UL Safety Standard:

- UL 110, Standard for Sustainability for Mobile Phones

Member of the ANSI/UL TC 2272 – *Electrical Systems for Personal E-Mobility Devices*, that is responsible for maintaining the following UL Safety Standard:

- UL 2272, Standard for Electrical Systems for Personal E-Mobility Devices

Member of the ANSI/UL TC 2056 – *Power Banks*, that is responsible for maintaining the following UL Safety Standard:

- UL 2056, Outline of Investigation for Safety of Power Banks

Member of the ANSI/UL TC 2849 – *Electrical Systems for EBikes*, that is responsible for maintaining the following UL Safety Standard:

- UL 2849, Standard for Electrical Systems for EBikes

Member of the ANSI/UL TC 82 – *Electric Gardening Appliances*, that is responsible for maintaining the following UL Safety Standards:

- UL 82, Standard for Electric Gardening Appliances
- UL 1090, Standard for Electric Snow Movers
- UL 1447, Standard for Electric Lawn Mowers
- UL 1602, Standard for Gasoline-Engine-Powered, Rigid-Cutting-Member Edgers and Edger: Trimmers
- UL 60745-2-15, Hand-Held -Operated Electric Tools – Safety – Part 2-15: Particular Requirements for Hedge Trimmers
- UL 62841-4-1, Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery – Safety – Part 4-1: Particular Requirements For Chain Saws
- UL 62841-4-2, Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery – Safety – Part 4-2: Particular Requirements For Hedge Trimmers
- UL 62841-4-3, Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery – Safety – Part 4-3: Particular Requirements For Pedestrian Controlled Walk-Behind Lawnmowers
- UL 62841-4-4, Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery – Safety – Part 4-4: Particular Requirements For Lawn Trimmers, Lawn Edge Trimmers, Grass Trimmers, Brush Cutters and Brush Saws
- UL 62841-4-1000, Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery – Safety – Part 4-1000: Particular Requirements For Utility Machines

Member of the ANSI/UL TC 745 – *Electric Tools*, that is responsible for maintaining the following UL Safety Standards:

- UL 987, Standard for Stationary and Fixed Electric Tools
- UL 1097, Double Insulation Systems for Use in Electrical Equipment
- UL 745-1, Standard for Portable Electric Tools
- UL 60745-1, Hand-Held Motor-Operated Electric Tools – Safety – Part 1: General Requirements
- UL 745-2-31, Particular Requirements for Diamond Core Drills
- UL 745-2-32, Particular Requirements for Magnetic Drill Presses
- UL 60745-2-1, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-1: Particular Requirements for Drills and Impact Drills
- UL 60745-2-2, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-2: Particular Requirements for Screwdrivers and Impact Wrenches
- UL 60745-2-3, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-3: Particular Requirements for Grinders, Polishers and Disk-Type Sanders
- UL 60745-2-4, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-4: Particular Requirements for Sanders and Polishers Other Than Disk Type
- UL 60745-2-5, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-5: Particular Requirements for Circular Saws
- UL 60745-2-6, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-6: Particular Requirements for Hammers
- UL 60745-2-8, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-8: Particular Requirements for Shears and Nibblers
- UL 60745-2-9, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-9: Particular Requirements for Tappers
- UL 60745-2-11, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-11: Particular Requirements for Reciprocating Saws
- UL 60745-2-12, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-12: Particular Requirements for Concrete Vibrators
- UL 60745-2-13, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-13: Particular Requirements for Chain Saws
- UL 60745-2-14, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-14: Particular Requirements for Planers
- UL 60745-2-16, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-16: Particular Requirements for Tackers
- UL 60745-2-17, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-17: Particular Requirements for Routers and Trimmers
- UL 60745-2-18, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-18: Particular Requirements for Strapping Tools
- UL 60745-2-19, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-19: Particular Requirements for Jointers
- UL 60745-2-20, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-20: Particular Requirements for Band Saws
- UL 60745-2-21, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-21: Particular Requirements for Drain Cleaners
- UL 60745-2-22, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-22: Particular Requirements for Cut-Off Machines
- UL 60745-2-23, Hand-Held Motor-Operated Electric Tools – Safety – Part 2-23: Particular Requirements for Die Grinders and Small Rotary Tools

- UL 2565, Standard for Manual and Semi-Automatic Metal Sawing Machines
- UL 62841-2-1, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-1: Particular Requirements for Hand-Held Drills and Impact Drills
- UL 62841-2-2, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-2: Particular Requirements for Hand-Held Screwdrivers and Impact Wrenches
- UL 62841-2-3, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-3: Particular Requirements for Hand-Held Grinders, Disc-Type Polishers and Disc-Type Sanders
- UL 62841-2-4, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-4: Particular Requirements for Hand-Held Sanders and Polishers Other Than Disk Type
- UL 62841-2-5, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-5: Particular Requirements for Hand-Held Circular Saws
- UL 62841-2-6, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-6: Particular Requirements for Hand-Held Hammers
- UL 62841-2-8, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-8: Particular Requirements for Hand-Held Shears and Nibblers
- UL 62841-2-9, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-9: Particular Requirements for Hand-Held Tappers and Threaders
- UL 62841-2-10, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-10: Particular Requirements for Hand-Held Mixers
- UL 62841-2-11, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-11: Particular Requirements for Hand-Held Reciprocating Saws
- UL 62841-2-14, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-14: Particular Requirements for Hand-Held Planers
- UL 62841-2-17, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-14: Particular Requirements for Hand-Held Routers
- UL 62841-2-21, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2-14: Particular Requirements for Hand-Held Drain Cleaners
- UL 62841-3-1, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 3-1: Particular Requirements for Transportable Table Saws
- UL 62841-3-4, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 3-4: Particular Requirements for Transportable Bench Grinders
- UL 62841-3-6, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 3-6: Particular Requirements for Transportable Diamond Drills With Liquid System
- UL 62841-3-7, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 3-7: Particular Requirements for Transportable Wall Saws
- UL 62841-3-9, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 3-9: Particular Requirements for Transportable Mitre Saws

- UL 62841-3-10, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 3-10: Particular Requirements for Transportable Cut-Off Machines
- UL 62841-3-13, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 3-13: Particular Requirements for Transportable Drills
- UL 62841-3-14, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 3-14: Particular Requirements for Transportable Drain Cleaners
- UL 62841-3-1000, Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 3-1000: Particular Requirements for Transportable Laser Engravers

Member of the ANSI/UL TC 1449 – *Surge Protectors*, that is responsible for maintaining the following UL Safety Standard:

- UL 1449, Standard for Surge Protective Devices

Member of the ANSI/UL TC 1053 – *Ground Fault Sensing And Relaying Equipment*, that is responsible for maintaining the following UL Safety Standard:

- UL 1053, Standard for Ground-Fault Sensing and Relaying Equipment

Member of the ANSI/UL TC 943 – *Ground-Fault Circuit-Interrupters*, that is responsible for maintaining the following UL Safety Standards:

- UL 943, Ground-Fault Circuit-Interrupters
- UL 943B, Standard for Appliance Leakage-Current Interrupters

Member of the ANSI/UL TC 1699 – *Arc-Fault Circuit-Interrupters*, that is responsible for maintaining the following UL Safety Standard:

- UL 1699, Standard for Arc-Fault Circuit-Interrupters

Member of the ANSI/UL TC 62446 – *Photovoltaic Systems – Requirements for Testing, Documentation And Maintenance – Grid Connected Systems*, that is responsible for maintaining the following UL Safety Standards:

- UL 62093, Standard for Balance-of-Systems Components for Photovoltaic Systems – Design Qualification Natural Environments

Member of the ANSI/UL TC 1699B – *Photovoltaic (PV) DC Arc-Fault Circuit Protection*, that is responsible for maintaining the following UL Safety Standard:

- UL 1699B, Standard for Photovoltaic (PV) DC Arc-Fault Circuit Protection

Member of the ANSI/UL TC 1741 – *Inverters, Converters, And Controllers For Use In Independent Power Systems*, that is responsible for maintaining the following UL Safety Standards:

- UL 1741, Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
- UL 62109-1, Standard for Safety of Power Converters for use in Photovoltaic (PV) Power Systems – Part 1: General Requirements
- UL 62109-2, Standard for Safety of Power Converters for use in Photovoltaic (PV) Power Systems – Part 2: Particular Requirements for Inverters

- UL 62109-3, Standard for Safety of Power Converters for use in Photovoltaic (PV) Power Systems – Part 3: General Requirements for Electronic Devices in Combination With Photovoltaic Elements
- UL 63112, Photovoltaic (PV) Arrays – Earth Fault Protection Equipment – Safety and Safety-Related Functionality

Member of the ANSI/UL TC 3741 – *Photovoltaic Hazard Control*, that is responsible for maintaining the following UL Safety Standard:

- UL 3741, Standard for Photovoltaic Hazard Control

Member of the ANSI/UL TC 8801 – *Photovoltaic (PV) Luminaire Systems*, that is responsible for maintaining the following UL Safety Standard:

- UL 8801, Standard for Photovoltaic (PV) Luminaire Systems

Member of the ANSI/UL TC 6703 – *Connectors for Use in Photovoltaic (PV) Systems*, that is responsible for maintaining the following UL Safety Standard:

- UL 6703, Standard for Connectors for Use in Photovoltaic (PV) Systems
- UL 9703, Outline of Investigation for Distributed Generation Wiring Harness
- UL 62852, Connectors for DC-Application in Photovoltaic Systems – Safety Requirements

Member of the ANSI/UL TC 1598 – *Luminaires*, that is responsible for maintaining the following UL Safety Standards:

- UL 1574, Standard for Track Lighting Systems
- UL 1598, Standard for Luminaires
- UL 1598A, Standard for Supplemental Requirements for Luminaires for Installation on Marine Vessels
- UL 1598B, Standard for Supplemental Requirements for Luminaire Reflector Kits for Installation on Previously Installed Fluorescent Luminaires

Member of the ANSI/UL TC 8750 – *Solid State And Light Emitting Diode (LED) Lighting*, that is responsible for maintaining the following UL Safety Standard:

- UL 8750, Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products

Member of the ANSI/UL TC 2735 – *Electric Utility Meters*, that is responsible for maintaining the following UL Safety Standard:

- UL 2735, Standard for Electric Utility Meters

Member of the ANSI/UL TC 1558 – *Metal-Enclosed Low-Voltage Power Circuit Break Switchgear*, that is responsible for maintaining the following UL Safety Standards:

- UL 1062, Standard for Unit Substations
- UL 1558, Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear

Member of the ANSI/UL TC 98 – *Power Switching Devices*, that is responsible for maintaining the following UL Safety Standards:

- UL 98, Standard for Enclosed and Dead-Front Switches
- UL 363, Standard for Knife Switches
- UL 977, Standard for Fused Power-Circuit Devices
- UL 1429, Standard for Pullout Switches

Member of the ANSI/UL TC 489 – *Molded-Case Circuit Breakers, Molded-Case Switches, and Supplementary Protectors*, that is responsible for maintaining the following UL Safety Standards:

- UL 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
- UL 489A, Standard for Circuit Breakers for Use in Communication Equipment
- UL 1066, Standard for Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures
- UL 1077, Standard for Supplementary Protectors for Use in Electrical Equipment

Member of the ANSI/UL TC 489B – *Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures For Use With Photovoltaic (PV) Systems*, that is responsible for maintaining the following UL Safety Standard:

- UL 489B, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures For Use With Photovoltaic (PV) Systems

Member of the ANSI/UL TC 1008 – *Transfers Switch Equipment*, that is responsible for maintaining the following UL Safety Standards:

- UL 1008, Standard for Transfer Switch Equipment
- UL 1008M, Standard for Transfer Switch Equipment, Meter Mounted
- UL 1008S, Standard for Solid-State Transfer Switches

Member of the ANSI/UL TC 347 – *Medium-Voltage AC Contactors, Controllers, and Control Centers*, that is responsible for maintaining the following UL Safety Standard:

- UL 347, Standard for Medium-Voltage AC Contactors, Controllers, and Control Centers

Member of the ANSI/UL TC 61800 – *Adjustable Speed Electrical Power Drive Systems*, that is responsible for maintaining the following UL Safety Standards:

- UL 61800, Standard for Adjustable Speed Electrical Power Drive Systems
- UL 61800-5-1, Standard for Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy
- UL 61800-5-2, Standard for Adjustable Speed Electrical Power Drive Systems – Part 5-2: Safety Requirements – Functional

Member of the ANSI/UL TC 2157 – *Electric Clothes Washing Machines, Extractors, and Dryers*, that is responsible for maintaining the following UL Safety Standards:

- UL 1206, Standard for Electric Commercial Clothes-Washing Equipment
- UL 1240, Standard for Electric Commercial Clothes-Drying Equipment
- UL 2157, Electric Clothes Washing Machines and Extractors
- UL 2158, Electric Clothes Dryers

Member of the ANSI/UL TC 60335-2-40 – *Heating and Cooling Equipment, Heat Pumps, Air Conditioners and Dehumidifiers*, that is responsible for maintaining the following UL Safety Standards:

- UL 1995, Heating and Cooling Equipment
- UL 1996, Electric Duct Heaters
- UL 60335-2-40, Household and Similar Electrical Appliances, Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers

Member of the ANSI/UL TC 873C – *Motor Thermal And Compressor Protectors*, that is responsible for maintaining the following UL Safety Standards:

- UL 2111, Standard for Overheating Protection for Motors
- UL 60730-2-3, Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Thermal Protectors for Ballasts for Tubular Fluorescent Lamps
- UL 60730-2-4, Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Thermal Motor Protectors for Motor Compressors of Hermetic and Semi-Hermetic Type
- UL 60730-2-10, Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Motor Starting Relays
- UL 60730-2-22, Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Thermal Motor Protectors

Member of the ANSI/UL TC 873D – *Timers and Time Switches*, that is responsible for maintaining the following UL Safety Standards:

- UL 917, Standard for Clock-Operated Switches
- UL 60730-2-7, Standard for Automatic Electric Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches

Member of the ANSI/UL TC 873E – *Temperature Controls, Appliance Controls*, that is responsible for maintaining the following UL Safety Standards:

- UL 244A, Solid-State Controls for Appliances
- UL 353, Limit Controls
- UL 873, Temperature-Indicating and -Regulating Equipment
- UL 60730-2-11A, Automatic Electrical Controls for Household and Similar Use - Part 2: Particular Requirements for Energy Regulators
- UL 60730-2-12, Automatic Electrical Controls for Household and Similar Use - Part 2: Particular Requirements for Automatic Electrically Operated Door Locks
- UL 60730-2-13, Automatic Electrical Controls for Household and Similar Use - Part 2: Particular Requirements for Humidity Sensing Controls
- UL 60730-2-13A, Automatic Electrical Controls for Household and Similar Use - Part 2: Particular Requirements for Humidity Sensing Controls
- UL 60730-2-15, Standard for Automatic Electrical Controls for Household and Similar Use - Part 2-15: Particular Requirements for Automatic Electrical Air Flow, Water Flow and Water Level Sensing Controls
- UL 60730-2-6, Automatic Electrical Controls for Household and Similar Use - Part 2: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements
- UL 60730-2-9, Automatic Electrical Controls for Household and Similar Use - Part 2: Particular Requirements for Temperature Sensing Controls

Member of the ANSI/UL TC 6691 – *Thermal-Links – Requirements And Application Guide*, that is responsible for maintaining the following UL Safety Standards:

- UL 60691, Standard for Thermal- Links – Requirements and Application Guide

Member of the ANSI/UL TC 6384 – *Fixed Capacitors For Use in Electronic Equipment*, that is responsible for maintaining the following UL Safety Standards:

- UL 60384-14, Safety Requirements for Fixed Capacitors for Use in Electronic Equipment – Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains

Member of the ANSI/UL TC 83 – *Power Cables*, that is responsible for maintaining the following UL Safety Standards:

- UL 44, Thermoset-Insulated Wires and Cables
- UL 66, Fixture Wire
- UL 83, Thermoplastic-Insulated Wires and Cables
- UL 83A, Standard for Fluoropolymer Insulated Wire
- UL 83B, Switchboard and Switchgear Wires and Cables
- UL 854, Standard for Service-Entrance Cables
- UL 1063, Standard for Machine-Tool Wires and Cables
- UL 1277, Standard for Electrical Power and Control Tray Cables With Optional Optical-Fiber Members
- UL 1426, Standard for Electrical Cables for Boats
- UL 1581, Reference Standard for Electrical Wires, Cables, and Flexible Cords
- UL 1685, Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
- UL 2556, Wire and Cables Test Methods

Member of the ANSI/UL TC 746 – *Polymeric Materials*, that is responsible for maintaining the following UL Safety Standards:

- UL 94, Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
- UL 746A, Standard for Polymeric Materials – Short Term Property Evaluations
- UL 746B, Standard for Polymeric Materials – Long Term Property Evaluations
- UL 746C, Standard for Polymeric Materials – Use in Electrical Equipment Evaluations
- UL 746D, Standard for Polymeric Materials – Fabricated Parts
- UL 1692, Standard for Polymeric Materials – Coil Forms
- UL 1694, Standard for Tests for Flammability of Small Polymeric Component Materials

Member of the ANSI/UL TC 583 – *Industrial Trucks*, that is responsible for maintaining the following UL Safety Standards:

- UL 558, Industrial Trucks, Internal-Combustion, Engine-Power
- UL 583, Electric-Battery-Powered Industrial Trucks

Member of the ANSI/UL TC 67 – *Power Distribution*, that is responsible for maintaining the following UL Safety Standards:

- UL 67, Standard for Panelboards
- UL 869A, Reference Standard for Service Equipment
- UL 891, Standard for Switchboards
- UL 1773, Standard for Termination Boxes

Member of the ANSI/CAN/UL TC 325 – *Door, Drapery, Gate, Louver, And Window Operators And Systems*, that is responsible for maintaining the following UL Safety Standards:

- UL 325, Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems

Member of the ANSI/UL TC 294– *Access Control Systems*, that is responsible for maintaining the following UL Safety Standards:

- UL 294, Standard for Access Control System Units

Member of the ANSI/UL TC 60730-1 – *Automatic Electrical Controls for Household And Similar Use*, that is responsible for maintaining the following UL Safety Standards:

- UL 60730-1, Standard for Automatic Electrical Controls – Part 1: General Requirements
- UL 244B, Standard for Field Installed and/or Field Connected Appliance Controls

Member of the ANSI/UL TC 498 – *Attachment Plug And Receptacles*, that is responsible for maintaining the following UL Safety Standards:

- UL 498, Standard for Attachment Plugs and Receptacles
- UL 498B, Outline of Investigation for Receptacles with Integral Switching Means
- UL 498C, Standard for Flatron and Appliance Plugs
- UL 498D, Attachment Plugs, Cord Connectors, and Receptacles with Arcuate (Locking Type) Contacts
- UL 498E, Attachment Plugs, Cord Connectors and Receptacles – Enclosure Types for Environmental Protection
- UL 498F, Plugs, Socket-Outlets and Couplers with Arcuate (Locking Type) Contacts
- UL 498M, Marine Shore Power Inlets
- UL 1567, Standard for Receptacles and Switches Intended for Use with Aluminum Wire
- UL 1681, Standard for Wiring Device Configurations
- UL 62986, Standard for Plugs, Socket-Outlets and Couplers with Arcuate Contacts

Member of the ANSI/UL TC 231 – *Power Outlets*, that is responsible for maintaining the following UL Safety Standards:

- UL 231, Standard for Power Outlets

Member of the ANSI/UL TC 347A – *Medium Voltage Power Conversion Controllers*, that is responsible for maintaining the following UL Safety Standards:

- UL 347A, Standard for Medium Voltage Power Conversion Equipment

Member of the ANSI/UL TC 499 – *Electric Heating Appliances*, that is responsible for maintaining the following UL Safety Standards:

- UL 499, Standard for Electric Heating Appliances

Member of the ANSI/UL TC 507 – *Electric Fans and Power Ventilators*, that is responsible for maintaining the following UL Safety Standards:

- UL 507, Standard for Electric Fans
- UL 705, Standard for Safety for Power Ventilators
- UL 60335-2-80, Standard for Household and similar electrical appliances – Safety – Part 2-80: Particular requirements for fans.

Member of the ANSI/UL TC 858 – *Household Electric Ranges*, that is responsible for maintaining the following UL Safety Standards:

- UL 858, Standard for Household Electric Ranges

Member of the ANSI/UL TC 60730A – *Burner Controls*, that is responsible for maintaining the following UL Safety Standards:

- UL 372, Standard for Automatic Electrical Control for Household and Similar Use – Part2: Particular requirements for Burner Ignition Systems and Components
- UL 60730-2-5, Standard for Automatic Electrical Controls for Household and Similar Use, Part 2-5: Particular requirements for Automatic Electrical Burner Control Systems

Member of the ANSI/UL TC 859 – *Electric Personal Grooming Appliances*, that is responsible for maintaining the following UL Safety Standards:

- UL 859, Standard for Household Electric Personal Grooming Appliances
- UL 1727, Standard for Commercial Electric Personal Grooming Appliances

Member of the ANSI/UL TC 1026 – *Electric Household Cooking Appliances*, that is responsible for maintaining the following UL Safety Standards:

- UL 1026, Standard for Household Electric Cooking and Food Serving Appliances
- UL 1082, Standard for Household Electric Coffee Makers and Brewing-Type Appliances
- UL 1083, Standard for Household Electric Skillets and Frying-Type Appliances
- UL 60335-2-15, Household and Similar Electrical Appliances – Safety – Part 2 – 15: Particular requirements for Appliances for Heating Liquids

Member of the ANSI/UL TC 1310 – *Power Supplies*, that is responsible for maintaining the following UL Safety Standards:

- UL 697, Standard for Toy Transformers
- UL 1310, Standard for Class 2 Power Units
- UL 2089, Standard for Vehicle Battery Adapters

Member of the ANSI/UL TC 1411 – *Transformers For Audio, Radio, And Television Appliances*, that is responsible for maintaining the following UL Safety Standards:

- UL 1411, Standard for Transformers and Motor Transformers for Use in Audio-, Radio-, and Television-Type Appliances
- UL 1876, Standard for Isolating Signal and Feedback Transformers for Use in Electronic Equipment

Member of the ANSI/UL TC 1434 – *Thermistor-Type Devices*, that is responsible for maintaining the following UL Safety Standards:

- UL 1434, Standard for Thermistor-Type Devices

Member of the ANSI/UL TC 1647 – *Motor-Operated Massage And Exercise Machines*, that is responsible for maintaining the following UL Safety Standards:

- UL 1647, Standard for Motor-Operated Massage and Exercise Machines

Member of the ANSI/UL TC 1682 – *Plugs, Receptacles, And Cable Connectors Of The Pin And Sleeve Type Configurations*, that is responsible for maintaining the following UL Safety Standards:

- UL 1682, Standard for Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type
- UL 1686, Standard for Pin and Sleeve Configurations

Member of the ANSI/UL TC 2200 – *Stationary Engine Generator Assemblies*, that is responsible for maintaining the following UL Safety Standards:

- UL 2200, Standard for Stationary Engine Generator Assemblies

Member of the ANSI/UL TC 2200A – *Stationary Engine Generator Enclosures*, that is responsible for maintaining the following UL Safety Standards:

- UL 2200A, Standard for Outline of Investigation for Fire Containment Testing of Stationary Engine Generator Enclosures

Member of the ANSI/UL TC 2237 – *Multi-Point Interconnection Power Cable Assemblies For Industrial Machinery*, that is responsible for maintaining the following UL Safety Standards:

- UL 2237, Standard for Multi-Point Interconnection Power Cable Assemblies for Industrial Machinery

Member of the UL TC 60601-1 – *Medical and Dental Equipment*, that is responsible for maintaining the following UL Safety Standards:

- UL 2237, Medical Electrical Equipment, Part 1: General Requirements for Safety

Member of the ANSI/UL TC 6131 – *Programmable Controllers*, that is responsible for maintaining the following UL Safety Standards:

- UL 61010-2-201, Standard for Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-201: Particular requirements for Control Equipment
- UL 61131-2, Standard for Programmable Controllers – Part 2: Equipment Requirements and Tests

Member of the ANSI/UL TC 1998 – *Software*, that is responsible for maintaining the following UL Safety Standards:

- UL 1998, Standard for Software in Programmable Components

Member of the ANSI/UL TC 5500 – *Remote Software Updates*, that is responsible for maintaining the following UL Safety Standards:

- UL 5500, Standard for Safety for Remote Software Updates

Member of the ANSI/UL TC 9741 – *Electric Vehicle Power Export Equipment (EVPE)*, that is responsible for maintaining the following UL Safety Standards:

- UL 9741, Standard for Outline of Investigation for Bidirectional Electric Vehicle (EV) Charging System Equipment

Member of the ANSI/UL TC 2251 – *Plugs, Receptacles, And Couplers For Electric Vehicles*, that is responsible for maintaining the following UL Safety Standards:

- UL 2251, Standard for Plugs, Receptacles, and Couplers for Electric Vehicles

Member of the ANSI/UL TC 2263 – *Electric Vehicle Cable*, that is responsible for maintaining the following UL Safety Standards:

- UL 2263, Standard for Electric Vehicle Cable

Member of the ANSI/UL TC 2750 – *Wireless Power Transfer Equipment For Electric Vehicles*, that is responsible for maintaining the following UL Safety Standards:

- UL 2750, Standard for Wireless Power Transfer Equipment for Electric Vehicles

Member of the ANSI/UL TC 61058 – *Switches For Appliances*, that is responsible for maintaining the following UL Safety Standards:

- UL 2557, Standard for Membrane Switches
- UL 61058, Standard for Switches for Appliances
- UL 61058-1, Standard for Switches for Appliances – Part 1: General Requirements
- UL 61058-1-1, Standard for Switches for Appliances – Part 1-1: Requirements for Mechanical Switches
- UL 61058-1-2, Standard for Switches for Appliances – Part 1-2: Requirements for Electronic Switches
- UL 61058-2-1, Standard for Switches for Appliances – Part 2: Particular requirements for Cord Switches
- UL 61058-2-5, Standard for Switches for Appliances – Part 2-5: Particular requirements for Change-Over Selectors
- UL 61058-2-6, Standard for Switches for Appliances – Part 2-6: Particular requirements for Switches Used in Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery

Member of the ANSI/UL TC 61810 – *Electromechanical Elementary Relays*, that is responsible for maintaining the following UL Safety Standards:

- UL 61810, Standard for Electromechanical Elementary Relays
- UL 61810-1, Standard for Electromechanical Elementary Relays – Part 1: General Requirements

Member of the ANSI/UL TC 60947-4 – *Contactors And Motor-Starters*, that is responsible for maintaining the following UL Safety Standards:

- UL 508, Standard for Industrial Control Equipment
- UL 60947-1, Standard for Low-Voltage Switchgear and Controlgear – Part 1: General rules
- UL 60947-4, Standard for Contactors and Motor-Starters
- UL 60947-4-1, Standard for Low-Voltage Switchgear and Controlgear – Part 4-1: Contactors and Motor-Starters – Electromechanical Contactors and Motor-Starters
- UL 60947-4-2, Standard for Low-Voltage Switchgear and Controlgear – Part 4-2: Contactors and Motor-Starters – AC Semiconductor Motor Controllers and Starters

Member of the ANSI/UL TC 60947-5 – *Control Circuit Devices And Proximity Switches*, that is responsible for maintaining the following UL Safety Standards:

- UL 60947-5, Standard for Control Circuit Devices and Proximity Switches
- UL 60947-5-1, Standard for Low-Voltage Switchgear and Controlgear – Part 5-1: Control Circuit Devices and Switching Elements – Electromechanical Control Circuit Devices
- UL 60947-5-2, Standard for Low-Voltage Switchgear and Controlgear – Part 5-2: Control Circuit Devices and Switching Elements – Proximity Switches

- UL 60947-5-5, Standard for Low-Voltage Switchgear and Controlgear – Part 5-5: Control Circuit Devices and Switching Elements – Electrical emergency stop device with mechanical latching function

Member of the ANSI/UL TC 62841-1 – *Motor-Operated Tools And Garden Machinery*, that is responsible for maintaining the following UL Safety Standards:

- UL 62841-1, Standard for Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery – Safety – Part1: General Requirements

Member of the ANSI/UL TC 982 – *Motor-Operated Household Appliances*, that is responsible for maintaining the following UL Safety Standards:

- UL 982, Standard for Motor-Operated Household Food Preparing Machines

Member of the ANSI/UL TC 48 – *Electric Signs*, that is responsible for maintaining the following UL Safety Standards:

- UL 48, Standard for Electric Signs
- UL 879A, Standard for LED Sign and Sign Retrofit Kits

Member of the ANSI/UL TC 96 – *Lightning Protection Components*, that is responsible for maintaining the following UL Safety Standards:

- UL 96, Standard for Lightning Protection Components
- UL 96A, Standard for Installation Requirements for Lightning Protection Systems

Member of the ANSI/UL TC 197 – *Commercial Cooking Appliances*, that is responsible for maintaining the following UL Safety Standards:

- UL 197, Standard for Commercial Electric Cooking Appliances

Member of the ANSI/UL TC 335A – *Household and Similar Electrical Appliances – General Requirements*, that is responsible for maintaining the following UL Safety Standards:

- UL 60335-1, Standard for Safety of Household and Similar Appliances, Part 1: General Requirements

Member of the ANSI/UL TC 335B – *Hermetic Refrigerant Motor-Compressors – General Requirements*, that is responsible for maintaining the following UL Safety Standards:

- UL 60335-2-34, Standard for Safety of Household and Similar Appliances - Safety, Part 2-34: Particular requirements for Motor-Compressors

Member of the ANSI/UL TC 484 – *Room Air Conditioners*, that is responsible for maintaining the following UL Safety Standards:

- UL 484, Standard for Room Air Conditioners

Member of the ANSI/UL TC 563 – *Ice Makers*, that is responsible for maintaining the following UL Safety Standards:

- UL 563, Standard for Ice Makers

Member of the ANSI/UL TC 574 – *Electric Oil Heaters*, that is responsible for maintaining the following UL Safety Standards:

- UL 574, Standard for Electric Oil Heaters

Member of the ANSI/UL TC 817 – *Cord Sets and Power-Supply Cords*, that is responsible for maintaining the following UL Safety Standards:

- UL 817, Standard for Cord Sets and Power-Supply Cords

Member of the ANSI/UL TC 924 – *Emergency Lighting and Power Equipment*, that is responsible for maintaining the following UL Safety Standards:

- UL 924, Standard for Emergency Lighting and Power Equipment

Member of the ANSI/UL TC 998 – *Humidifiers*, that is responsible for maintaining the following UL Safety Standards:

- UL 998, Standard for Humidifiers

Member of the ANSI/UL TC 1008A – *Medium-Voltage Transfer Switches*, that is responsible for maintaining the following UL Safety Standards:

- UL 1008A, Standard for Transfer Switch Equipment, Over 1000 Volts

Member of the ANSI/UL TC 1562 – *Transformers, Distribution, Dry-Type Over 600 Volts*, that is responsible for maintaining the following UL Safety Standards:

- UL 1562, Standard for Transformers, Distribution, Dry-Type Over 600 Volts

Member of the ANSI/UL TC 1563 – *Electric Spas, Equipment Assemblies, and Associated Equipment*, that is responsible for maintaining the following UL Safety Standards:

- UL 1563, Standard for Electric Spas, Equipment Assemblies, and Associated Equipment

Member of the ANSI/UL TC 1673 – *Electric Radiant Heating Panels and Cables*, that is responsible for maintaining the following UL Safety Standards:

- UL 1673, Standard for Electric Space Heating Cables
- UL 1693, Standard for Electric Radiant Heating Panels and Heating Panel Sets
- UL 2683, Standard for Electric Heating Systems for Floor and Ceiling Installation

Member of the ANSI/UL TC 1740 – *Robot and Robotic Equipment*, that is responsible for maintaining the following UL Safety Standards:

- UL 1740, Standard for Robots and Robotic Equipment

Member of the ANSI/UL TC 1778 – *Uninterruptible Power Systems*, that is responsible for maintaining the following UL Safety Standards:

- UL 1778, Standard for Uninterruptible Power Systems

Member of the ANSI/UL TC 1974 – *Electric Spas, Equipment Assemblies, and Associated Equipment*, that is responsible for maintaining the following UL Safety Standards:

- UL 1563, Standard for Electric Spas, Equipment Assemblies, and Associated Equipment

Member of the ANSI/UL TC 2743 – *Portable Power Packs*, that is responsible for maintaining the following UL Safety Standards:

- UL 2743, Standard for Portable Power Packs

Member of the ANSI/UL TC 6065 – *Audio, Video And Similar Electronic Apparatus – Safety Requirements*, that is responsible for maintaining the following UL Safety Standards:

- UL 150, Standard for Antenna Rotators
- UL 452, Standard for Antenna – Discharge Units
- UL 469, Standard for Musical Instruments and Accessories
- UL 813, Standard for Commercial Audio Equipment
- UL 1412, Standard for Fusing Resistors and Temperature-Limited Resistors for Radio- and Television- Type Appliances
- UL 1413, Standard for High-Voltage Components for Television-Type-Appliances
- UL 1416, Standard for Overcurrent and Overtemperature Protectors for Radio- and Television- Type Appliances
- UL 1417, Standard for Special Fuses for Radio- and Television-Type Appliances
- UL 1492, Standard for Audio-Video Products and Accessories
- UL 1676, Standard for Conductive-Path and Discharge-Path Resistors for Use in Radio, Video-, or Television-Type Appliances
- UL 6500, Standard for Audio/Video and Musical Instrument Apparatus for Household, Commercial, and Similar General Use
- UL 60065, Standard for Audio, Video and Similar Electronic Apparatus – Safety Requirements

Member of the ANSI/UL TC 60335-2-8 – *Hair Clipping And Shaving*, that is responsible for maintaining the following UL Safety Standards:

- UL 60335-2-8, Standard for Household and Similar Electrical Appliances – Safety – Part 2-8: Particular requirements for Shavers, Hair Clippers, and Similar Appliances

Member of the ANSI/UL TC 1004-1 – *Motors*, that is responsible for maintaining the following UL Safety Standards:

- UL 1004-1, Standard for Rotating Electrical Machines – General Requirements
- UL 1004-2, Standard for Impedance Protected Motors
- UL 1004-3, Standard for Thermally Protected Motors
- UL 1004-4, Standard for Electric Generators
- UL 1004-5, Standard for Fire Pump Motors
- UL 1004-6, Standard for Servo and Stepper Motors
- UL 1004-7, Standard for Electronically Protected Motors
- UL 1004-8, Standard for Inverter Duty Motors
- UL 1004-9, Standard for Form Wound and Medium Voltage Rotating Electrical Machines
- UL 1004-10, Standard for Pool Pump Motors
- UL 60034-1, Standard for Rotating Electrical Machines – Part1: Rating and Performance
- UL 60034-2, Standard for Rotating Electrical Machines – Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)
- UL 60034-5, Standard for Rotating Electrical Machines – Part 5: Degrees of Protection Provided by the Integral Design of Rotating Electrical Machines (IP code) – Classification

## Professional Resume

Samuel G. Sudler, III, P.E., IntPE, DFE, F.NSPE, CFEI, CVFI (11/2023)

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Member of the ANSI/UL TC 60335-2-24 – *Refrigerating Appliances, Ice-Cream Appliances And Ice-Makers*, that is responsible for maintaining the following UL Safety Standards:

- UL 60335-2-24, Standard for Household and Similar Electrical Appliances – Safety – Part 2-24: Particular requirements for Refrigerating Appliances, Ice-Cream Appliances and Ice-Makers

Member of the ANSI/UL TC 60335-2-89 – *Commercial Refrigeration And Freezers, Unit Coolers, And Refrigerating Units*, that is responsible for maintaining the following UL Safety Standards:

- UL 412, Standard for Refrigeration Unit Coolers
- UL 427, Standard for Refrigerating Units
- UL 471, Standard for Commercial Refrigerators and Freezers
- UL 60335-2-89, Standard for Household and Similar Electrical Appliances – Safety – Part 2-89: Particular Requirements for Commercial Refrigerating Appliances and Ice-Makers with an Incorporated or Remote Refrigerant Unit or Motor-Compressor

## Honors

- Elected to President of the National Academy of Forensic Engineers (NAFE) and Chairman of the Board of Directors for NAFE, 2022
- Elected to Fellow (F.NSPE) by the National Society of Professional Engineers (NSPE) Board of Directors, 2020
- Appointed by NSPE President to serve as Chairman of the NSPE Board of Ethical Review, 2012-2013

## Publications

- “*The Evolution of Batteries Utilized in Outdoor Power Tools and Vehicles*,” Sudler, III, S.G., and Fogarty, A., Defense Research Institute (DRI), 2022
- “*Use of 3D Printing in Forensic Investigations*,” Sudler, III, S.G., and Swanson, J.E., Defense Research Institute (DRI), 2016
- “*The Forensic Engineer as an Expert: Developing Your Construction Defect Case Defense*,” Sudler, III, S.G., and Gridley, J.A., Defense Research Institute (DRI), 2011
- “*Management of Catastrophic Industrial or Construction Disasters from Prevention to Preservation*,” Dukes, W.W., Sudler, III, S.G., and Culbreath, G.T., Federation of Defense and Corporate Council (FDCC), 2010
- “*Who’s In Charge Here? Management of the Complex Fire Scene*,” Sudler, III, S.G., Defense Research Institute (DRI), 2008

## Professional Affiliations

Past-President and Member of Board of Directors for the National Academy of Forensic Engineers (NAFE)

Former Senior Vice President and Member of Board of Directors for the National Academy of Forensic Engineers (NAFE)

Former Director-At-Large, Board of Directors for the National Academy of Forensic Engineers (NAFE)

Chairman, Ethics Committee for the National Academy of Forensic Engineers (NAFE)

Senior Member, National Academy of Forensic Engineers (NAFE)

Former Member, National Institute for Engineering Ethics (NIEE) Executive Committee

Former Chairman, National Society of Professional Engineers (NSPE) Board of Ethical Review (BER)  
Former Northeast Regional Representative, National Society of Professional Engineers Board of Ethical Review  
Senior Member, Institute of Electrical and Electronic Engineers (IEEE)  
Senior Member, International Society of Automation (ISA)  
Council Record Holder Designated Model Law Engineer (MLE), National Council of Examiners for Engineers and Surveyors (NCEES)  
Former Chairman, NSPE/PEI Young Engineers Advisory Council (YEAC)  
Former Vice President, Illinois Society of Professional Engineers (ISPE)  
Licensed Member, National Society of Professional Engineers (NSPE)  
Member, NSPE/Professional Engineer in Industry Practice Division  
Member, IEEE/Consumer Electronics Society  
Member, IEEE/Industry Applications Society  
Member, IEEE/Power and Energy Society  
Member, National Fire Protection Association (NFPA)  
Member, NFPA/Electrical Section  
Participating Member, American Society of Testing and Materials (ASTM)  
Voting Member, ASTM/Nondestructive Testing Committee (Section E07)  
Voting Member, ASTM/Forensic Sciences Committee (Section E30)  
Voting Member, ASTM/Forensic Engineering Committee (Section E58)  
Voting Member, ASTM/Electrical and Electronic Insulating Materials Committee (Section D09)  
Member, National Association of Fire Investigators (NAFI)  
Member, International Association of Arson Investigators (IAAI)  
Member, Institution of Engineering and Technology (MIET), formerly the Institute of Electrical Engineers (IEE)

### **Additional Training**

- 2023 – NAFE Application of Engineering in Jurisprudence Systems (8 PDHs)
- 2023 – NAFE Ethics, Forensic Analysis, and Professional Practice (8 PDHs)
- 2022 – NAFE Application of Engineering in Jurisprudence Systems (16 PDHs)
- 2022 – NAFE Ethics, Forensic Analysis, and Professional Practice (16 PDHs)
- 2021 – NAFE Application of Engineering in Jurisprudence Systems (4 PDHs)
- 2021 – NAFE Ethics, Forensic Analysis, and Professional Practice (4 PDHs)
- 2020 – NAFE Application of Engineering in Jurisprudence Systems (11 PDHs)
- 2020 – NAFE Ethics, Forensic Analysis, and Professional Practice (11 PDHs)
- 2019 – NAFE Application of Engineering in Jurisprudence Systems (7 PDHs)
- 2019 – NAFE Ethics, Forensic Analysis, and Professional Practice (7 PDHs)
- 2018 – NAFE Application of Engineering in Jurisprudence Systems (8 PDHs)
- 2018 – NAFE Ethics, Forensic Analysis, and Professional Practice (8 PDHs)
- 2017 – NAFE Application of Engineering in the Jurisprudence System (8 PDHs)
- 2017 – NAFE Ethics, Forensic Analysis, and Professional Practice (8 PDHs)
- 2016 – NAFE Application of Engineering in the Jurisprudence System (8 PDHs)
- 2016 – NAFE Ethics, Forensic Engineering, and Analytical Techniques (8 PDHs)
- 2015 – NAFE Application of Engineering in the Jurisprudence System (8 PDHs)
- 2015 – NAFE Ethics, Rules & Laws, Daubert-Proofing & Reasonably Dangerous Products (8 PDHs)

Professional Resume

Samuel G. Sudler, III, P.E., IntPE, DFE, F.NSPE, CFEI, CVFI (11/2023)

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- 2014 – NAFE General Topics in Forensic Engineering (8 PDHs)
- 2014 – NAFE Ethics, Use and Misuse of Standards for Forensic Engineers (8 PDHs)
- 2013 – NAFE General Topics in Forensic Engineering (8 PDHs)
- 2013 – NAFE Ethical Considerations for Forensic Engineers (8 PDHs)
- 2012 – NAFE General Topics in Forensic Engineering (8 PDHs)
- 2012 – NAFE Reports, Affidavits, Motions in Limine, Depositions, Court Testimony and Ethics (8 PDHs)
- 2011 – NAFE General Topics in Forensic Engineering (8 PDHs)
- 2011 – NAFE Reports, Harassment, Contracts and Challenges (8 PDHs)
- 2010 – NAFE General Topics in Forensic Engineering (8 PDHs)
- 2010 – NAFE Regular Depositions, Subpoenas, Records Production, Errata Sheets, Video Depositions, Rights and Responsibilities (8 PDHs)
- 2009 – NAFE Forensic Engineer (FE) Evidence: Gathering, Storing, Analyzing, Documenting, Reporting, Copyright & Patent Rights (8PDHs)
- 2009 – NAFE General Topics in Forensic Engineering (8 PDHs)
- 2008 – NAFI/NFPA Advanced Fire, Arson & Explosion Investigation Training Program
- 2008 – NAFE Medical Information & Standards for Engineering Evidence (8 PDHs)
- 2008 – NAFE General Topics in Forensic Engineering (8 PDHs)
- 2008 – Fire Investigation Methods and Updates on Current Investigative Issues, SEA, Ltd.
- 2007 – NAFE General Topics in Forensic Engineering (8 PDHs)
- 2007 – IEEE Electric Drives: Understanding Basics (3 PDHs)
- 2007 – IEEE An Introduction to Power Electronics (3 PDHs)
- 2007 – IEEE Introduction to Instrumentation (3 PDHs)
- 2007 – IEEE Cyber Security of Substation Control & Diagnostic Systems (3 PDHs)
- 2005 – NAFE Daubert Challenges to Forensic Engineers and Scientific Methodologies (8 CEUs)
- 2005 – NAFE Daubert Challenges to Forensic Engineers and Scientific Methodologies (8 CEUs)
- 2005 – NSPE Risky Business: What Causes Claims and How to Avoid Them (1.5 PDHs)
- 2005 – NSPE Engineering Ethics: You Be The Judge (1.5 PDHs)
- 2004 – National Academy of Forensic Engineers (NAFE), General Topics in Forensic Engineering (8 CEUs)
- 2004 – NSPE Global Issues in Engineering: Licensure and Legislature (1.5 PDHs)
- 2004 – National Society of Professional Engineers (NSPE) Engineering Council (EC) Accreditation Board for Engineering and Technology (ABET) Evaluator Training (6 PDHs)
- 2003 – Vehicle Fire, Arson & Explosion Investigation Science & Technology Seminar, NAFI, Eastern Kentucky University
- 2003 – IAAI Electrical Appliance Fires, Gas Appliance and Explosions, Wood-Burning Appliance Fires (3 CEUs)
- 2002 – NFPA National Electrical Code Seminar (2.1 CEUs)
- 1999 – Learning Tree International Visual Basic and COM for Enterprising Applications: Hands On (3 CEUs)
- 1998 – ABB Electrical Service M93 Course for IRB 6000 Robots
- 1998 – ABB S3 Programming Course for IRB 6000 Robots
- 1998 – Rockwell Automation Drive Systems Automax Intermediate Programming
- 1997 – College of DuPage C Programming Language (5 credit hours)
- 1997 – IDC Technical Training Course on Practical Process Control for Engineers and Technicians

- 1996 – ACS Technical Training Course on Grounding, Shielding, and Surge Protection of Electrical Equipment for Instrumentation and Control
- 1996 – Intellution DOS FIX DMACS Programming
- 1995 – GE Series 90-70 PLC Basic Programming
- 1995 – Siemens Industrial Automation Inc., S5 Programming II

### **Courses Taught/Presentations**

- 2022 – “Lithium-Ion Battery Forensic Investigations,” McCoy Leavitt Laskey Fire Science Litigation Seminar, Ponte Vedra Beach, Florida
- 2022 – “Practical Real-World Ethical Challenges a Forensic Engineer Faces and How to Contend with those Challenges,” National Academy of Forensic Engineers (NAFE), Tucson, Arizona
- 2021 – “*Ethics for Forensic Engineers*,” National Academy of Forensic Engineers (NAFE), Virtual Meeting
- 2020 – “*2020 Update on Ethics, Law and Public Policy Affecting Forensic Engineers*,” National Academy of Forensic Engineers (NAFE), San Diego, California
- 2019 – “*Electrical Systems and the Electrical Grid: Supplying Power or Causing the Program?*,” McCoy Leavitt Laskey Fire Science and Litigation Seminar, San Antonio, Texas
- 2019 – “*Update on Ethics, Law and Public Policy affecting Forensic Engineers*,” National Academy of Forensic Engineers (NAFE), Orlando, Florida
- 2018 – “*Evidence Preservation Protocols*,” Defense Research Institute (DRI) Fire Science Litigation Seminar, Washington, DC
- 2018 – “*Ethics and Engineers*,” National Society of Professional Engineers (NSPE), Las Vegas, Nevada
- 2018 – “*Effective Use of Demonstrative Exhibits*,” USLAW, Lloyds of London, London, England
- 2018 – “*Electronic Cigarette Forensic Investigations*,” Ark Syndicate Management Limited, London, England
- 2018 – “*Ethics, Law and Public Policy Affecting Forensic Engineers*,” National Academy of Forensic Engineers (NAFE), Phoenix, Arizona
- 2017 – “*Ethics and Engineering*,” National Society of Professional Engineers (NSPE), Atlanta, Georgia
- 2017 – “*Ethics for Engineers*,” National Academy of Forensic Engineers (NAFE), New Orleans, Louisiana
- 2016 – “*Use of 3D Printing in Forensic Investigations*,” Defense Research Institute (DRI) Fire and Casualty Seminar, New Orleans, Louisiana
- 2016 – “*Ethics for Engineers*,” National Academy of Forensic Engineers (NAFE), Tampa, Florida
- 2015 – “*Ethics in Engineering*,” National Academy of Forensic Engineers (NAFE), Hollywood Beach, Florida
- 2012 – “*Experiential Adjusters Boot Camp*,” USLAW, Lloyds of London, London, England
- 2011 – “*The Forensic Engineer as an Expert: Developing Your Construction Defect Case Defense*,” Defense Research Institute (DRI), Phoenix, Arizona
- 2010 – “*Management of Catastrophic Industrial or Construction Disasters from Prevention to Preservation*,” Federation of Defense and Corporate Council (FDCC), Munich, Germany
- 2008 – “*Who’s In Charge Here? Management of the Complex Fire Scene*,” Defense Research Institute (DRI) Fire and Casualty Seminar, Chicago, Illinois

Professional Resume

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2005 – “*Investigation of Electrical Fires,*” International Association of Arson Investigators (IAAI) Illinois Chapter, 22<sup>nd</sup> Annual Fire Investigation Training Conference, Urbana, Illinois

2005 – “*Electrical Engineering Subrogation Principles,*” National Association of Subrogation Professionals (NASP) North Central Region Educational Session, Chicago, Illinois

**Testimony Log\***

**Samuel G. Sudler, III, P.E., IntPE, DFE, CFEI, CVFI**

**9/13/2020 - 9/13/2024**

\*Maintained in accordance with Federal Rule 26



| Case Caption   | Type       | Date       | Venue  | Court No.               |
|--|------------|------------|--|-------------------------|
| Dearvin Sneed v. Crown Equipment Corporation and Target Corporation  | Deposition | 7/25/2024  | In the United States District Court for the Northern District of Texas Dalls Division                  | 3:23-CV-743             |
| Kevin Cole and Selena Cole v. Crown Equipment Corporation  | Deposition | 5/8/2024   | In The Starke Circuit Court Sitting at Knox, Indiana   | 3:22-cv-00935           |
| Maxwell's Pharmacy, Inc. vs. Lakeside Pharmacy Holdings, Inc., Pearl Street Beverage, Inc., and MMG Insurance Company  | Deposition | 3/26/2024  | State of Vermont Superior Court Civil Division   | 22-cv-02256             |
| Brenda Farmer, et al. v. Dell, Inc.  | Deposition | 2/15/2024  | Court of Gwinnett County State of Georgia  | 20-C-05351-S5           |
| Caleb Rodriguez v. Crown Equipment Corporation   | Deposition | 11/17/2023 | In the Court of the Thirteenth Judicial Circuit in and for Hillsborough County, Florida Civil Division | 19-CA-001456            |
| Miller's Capital Insurance Company a/s/o GJK Properties, LLC. v. Express Roofing & Construction LLC, et al.,   | Deposition | 6/12/2023  | In the Circuit Court for Baltimore County  | C-03-CV-22-003462       |
| Mikey Sloan v. Vapors Smoke Shop, LLC, et al.  | Deposition | 3/30/2023  | In The State Court of Chatham County Sate of Georgia   | STCV21-02444            |
| Jane Humphrey, Personal Representative of the Estate of Jeff Humphrey, Deceased v. McAbee Medical, Inc.; et al., Calvin King and Lettie King v. McAbee Medical, Inc.; et al. | Deposition | 11/22/2022 | In The Circuit Court of Madison County, Alabama  | 47-CV-2019-900674       |
| Edward E. Hardy v. Crown Equipment Corporation, et al.   | Deposition | 9/23/2022  | United States District Court Southern District of New York   | 7:21-cv-10310(KMK)(JCM) |
| Jonathan Freed v. Samsung SDI Co., Ltd.; and DOES 1 through 10, inclusive  | Deposition | 6/2/2022   | Superior Court of California County of San Francisco   | Case No. CGC-17-560656  |
| Ishynique McCoy v. T-Mobile Store, et al.  | Deposition | 2/11/2022  | In the United States District Court for the Eastern District of Pennsylvania                           | No.: 2:18-CV-04079-AB   |

**Testimony Log\***

**Samuel G. Sudler, III, P.E., IntPE, DFE, CFEI, CVFI**

**9/13/2020 - 9/13/2024**

\*Maintained in accordance with Federal Rule 26



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|--|------------|------------|--|-----------------------|
| Estate of Victoriano Diaz, Deceased, by its Special Administrator, Victoria Davis Dávila, et al. v. ABC Insurance Company, Wisconsin Electric Power Company, DEF Insurance Company and U.S. Black Spruce Enterprise, Group, Inc. | Deposition | 2/9/2022   | State of Wisconsin Circuit Court, Milwaukee County                                 | Case No.: 20-CV-5003  |
| Philadelphia Insurance Company v. Chauvet & Sons LLC, et al.   | Deposition | 10/6/2021  | United States District Court for Eastern District of Pennsylvania                  | 2:20-cv-01277-CMR     |
| Reggie Bridges and Yashica Bridges v. Cloud 9 Vapors, LLC; Samsung SDI Co., Ltd; Samsung SDI America, Inc.; and John Does 1-10; Vapor Supply, LLC  | Deposition | 8/25/2021  | In the Circuit Court of Forrest County, Mississippi                                | 18CI1:19-cv-00117     |
| State Farm Fire & Casualty Co. a/s/o Donald Himlin v. Twin Star Home   | Deposition | 4/23/2021  | In the United States District Court for the Eastern District of Pennsylvania       | 5:20-cv-03973         |
| MCI Communications Services, Inc. and MCIMetro Access Transmission Services Corp. v. Thayer Power & Communication Line Construction Company, LLC   | Deposition | 3/4/2021   | United States District Court Western District of North Carolina Charlotte Division | 3:19-cv-00379-RJC-DKC |
| Kristina Nolan, as parent and, natural guardian of, Karson Nolan, minor v. Steller Investment, LLC d/b/a Habits, et al.  | Deposition | 12/16/2020 | In the State Court of Henry County, Georgia  | STSV2019000956        |



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## FEE/COST SUMMARY

*Samuel G. Sudler, III, P.E., IntPE, CFEI*

Investigative and engineering analyses are conducted on a time-and-expense basis. SEA, Ltd. invoices for activities, including but not limited to, travel time, scene inspection, follow-up investigation, testing and analysis, documentation and report writing, court preparation, deposition and courtroom testimony. The hourly fee per individual is the same, regardless of the activity being performed on the project (travel, scene inspection, communication, deposition, trial, etc.). **The current billable rate per hour for Samuel G. Sudler, III is \$450.**

SEA, Ltd. also invoices for any out-of-pocket expenses on an actual cost basis. Other expenses may include, but are not limited to, travel costs, photographs, photocopies, police/fire/agency reports, postage, faxes, international long-distance telephone charges, supplies, equipment or tool rental when required, evidence storage fees, and special testing or laboratory services. Often, chemical laboratory charges are established on a fee-per-sample/per-test basis (i.e., fire debris by gas chromatography). Items not included in the fee-per-sample rate will either be quoted a rate and/or analysis performed at the chemist's regular hourly rate.

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